



Final Draft Environmental Assessment

San Antonio Creek Restoration

Vandenberg Air Force Base California

27 June 2008

Report Documentation Page			Form Approved OMB No. 0704-0188		
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE 27 JUN 2008		2. REPORT TYPE Environmental Assessment		3. DATES COVERED 00-00-2007 to 00-00-2008	
4. TITLE AND SUBTITLE San Antonio Creek Restoration, Vandenberg Air Force Base, California				5a. CONTRACT NUMBER FA4610-06-A-0002	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) 30th Space Wing Environmental Flight, 1028 Iceland Avenue, Vandenberg Air Force Base, CA, 93437-6010				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) 30th Space Wing Environmental Flight, 1028 Iceland Avenue, Vandenberg Air Force Base, CA, 93437-6010				10. SPONSOR/MONITOR'S ACRONYM(S) 30 CES/CEV	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT The Environmental Assessment(EA) addresses the potential environmental effects of restoring 0.875 mile of San Antonio Creek by remediating extensive damage to the banks and stream channel, restoring hydrologic function, enhancing stream stability, minimizing potential for further erosion, and beginning to return channel morphology to a proper functioning condition. The proposed project includes constructing in-stream rock riffle grade controls at seven sites and bioengineering bank stabilization at three sites within San Antonio Creek, between U.S. Highway 1 and the Lee Road Utility Bridge. The Final Draft EA concludes that there will be no significant environmental impacts resulting from the Proposed Action. The public comment period for this EA is June 27, 2008 through July 26, 2008. Comments may be sent to 30 CES/CEV, 1028 Iceland Avenue, Vandenberg Air Force Base, CA 93437-6010; e-mailed to 30CES.CEV@vandenberg.af.mil; or faxed to 805/606-3137. For questions, call Ms. Dina Ryan at 805/606-2839.					
15. SUBJECT TERMS San Antonio Creek, Vandenberg Air Force Base, habitat restoration, riparian restoration, wetland restoration, environmental effects, environmental impacts					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT 1	18. NUMBER OF PAGES 173	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

FINAL DRAFT

FINDING OF NO SIGNIFICANT IMPACT AND FINDING OF NO PRACTICABLE ALTERNATIVE

San Antonio Creek Restoration at Vandenberg Air Force Base, California

Pursuant to provisions of the National Environmental Policy Act (NEPA), 42 U.S. Code 4321 *et seq.*, implementing Council on Environmental Quality (CEQ) Regulations, 40 Code of Federal Regulations (CFR) 1500-1508, and 32 CFR Part 989, *Environmental Impact Analysis Process*, the U.S. Air Force (Air Force) conducted an assessment of the potential environmental consequences associated with restoring 0.875 mile of San Antonio Creek on Vandenberg Air Force Base (VAFB or Base), California.

The Environmental Assessment (EA), incorporated by reference to this finding, considers all potential impacts of the Proposed Action and No-Action Alternative, both as a solitary action, and cumulatively in conjunction with other projects at VAFB. The EA analyzes the potential environmental consequences of activities associated with the proposed creek restoration, and provides guidelines to avoid adverse environmental effects.

PROPOSED ACTION

The proposed project would remediate extensive damage to the banks and stream channel of San Antonio Creek, restore hydrologic function, enhance stream stability, minimize potential for further erosion, and begin to return channel morphology to a proper functioning condition. The restoration would entail constructing in-stream rock riffle grade controls at seven sites and bioengineering bank stabilization at three sites within San Antonio Creek, between U.S. Highway 1 and the Lee Road Utility Bridge. Constraints applicable to the Proposed Action are discussed under their relevant resource.

Only the No-Action Alternative is considered in addition to the Proposed Action. No other viable alternatives to the Proposed Action were identified. Implementation of the No-Action Alternative would result in the restoration and bank protection measures not being implemented within San Antonio Creek. Because the banks would remain unprotected, San Antonio Creek would continue to migrate toward San Antonio Road West, eventually undermining the roadway and forcing the closure of the road. In addition, the Lee Road Utility Bridge abutments could be undermined and fail during future major creek flows, threatening the bridge structure and utilities it supports.

SUMMARY OF FINDINGS

The analyses of the affected environment and environmental consequences of implementing the Proposed Action presented in the EA concluded that with implementation of the environmental protection and monitoring measures described in Chapter 4, no adverse effects should result to Earth Resources (Section 4.4), Hazardous Materials and Waste Management (Section 4.5), Human Health and Safety (Section 4.6), Land Use and Aesthetics (Section 4.7),

FINAL DRAFT

and Transportation (Section 4.8). In addition, the EA concluded that the Proposed Action would not affect Environmental Justice, Socioeconomics, and Solid Waste Management.

No cumulative adverse impacts should result from activities associated with the restoration of San Antonio Creek, when considered in conjunction with recent past and future projects on VAFB (Section 4.8).

While the Proposed Action is not located within the California Coastal Zone, given potential, temporary, downstream effects during implementation the Proposed Action, Vandenberg AFB will submit a Negative Determination to the California Coastal Commission and obtain concurrence prior to initiation of the project in accordance with the Coastal Zone Management Act.

Four areas of environmental consequences evaluated in the EA were determined to have the potential to result in less than significant impacts to the environment.

Air Quality

Fugitive dust emissions generated from equipment operating on exposed ground and combustive emissions from the equipment would cause adverse air quality impacts. However, no significant impacts are anticipated (see EA Sections 3.1 and 4.1). Emissions from the Proposed Action would not exceed significance thresholds; therefore, no adverse impacts to the region's air quality would occur. All measures described in the EA will be implemented to further decrease emissions during project activities.

Biological Resources

The proposed creek restoration has the potential to result in short-term temporary adverse effects to biological resources in the immediate area of disturbance, and long-term permanent beneficial effects from improved habitat and ecological function. Federal threatened and endangered species that occur or have the potential to occur within the project area include: unarmored threespine stickleback (*Gasterosteus aculeatus williamsoni*), California red-legged frog (*Rana aurora draytonii*), El Segundo blue butterfly (*Euphilotes battoides allyni*), and Gaviota tarplant (*Deinandra increscens* ssp. *villosa*). No significant adverse impacts to these species are anticipated with the implementation of the environmental protection and monitoring measures described in the EA.

Cultural Resources

Nine previously recorded archaeological sites and one isolated artifact are recorded within 0.25 mile of the proposed project area. Seven cultural resources are within or immediately adjacent to the creek restoration area. Project activities were developed to avoid adverse effects to known resources, where possible. However, one archaeological site could not be avoided. Because the site is deeply buried, VAFB assumes the site is eligible for the NRHP for the purposes of the proposed project only. Therefore, VAFB has determined that the Proposed Action would have an adverse effect to one historic property. This determination and the associated studies are documented within a Historic Property Survey Report, which was submitted to the California State Historic Preservation Officer (SHPO) for review and a request for concurrence. VAFB will seek measures to mitigate the project's adverse effects to acceptable levels with the SHPO and Santa Ynez Band of Chumash Indians. These measures will be contained within a Historic Property Treatment Plan, accompanied by a Memorandum of

FINAL DRAFT

Agreement (MOA). Upon signature of the MOA by consulting parties, the terms outlined in the Historic Property Treatment Plan would be fully implemented.

Water Resources

The Proposed Action would require coverage under the National Pollutant Discharge Elimination System (NPDES) Construction General Permit because the total disturbed area would be greater than one acre. A Storm Water Pollution Prevention Plan would be developed and implemented to maintain compliance with the NPDES Construction General Permit. During site preparation and construction activities, storm water/erosion best management practices (BMPs) would be implemented during and after any clearing, excavation, and grading. Long-term BMPs would be put in place to address storm water erosion after project completion. Implementing these procedures and requirements should prevent adverse effects as a result of restoration activities. No significant impacts are anticipated to water resources with the implementation of the environmental protection and monitoring measures described in the EA.

PRACTICABLE ALTERNATIVES

Because the Proposed Action would occur within the 100-year floodplain of San Antonio Creek, as defined by the Federal Emergency Management Agency, no practicable alternative to the Proposed Action is possible.

FINDING OF NO PRACTICABLE ALTERNATIVE

Pursuant to Executive Order 11990 and 32 CFR 989.14(g), the authority delegated in SAFO 791.1 and taking the information contained in the attached EA into consideration, I find that there is no practicable alternative to implementing the Proposed Action in a floodplain. The Proposed Action, as designed, includes all practicable measures to minimize harm. Before undertaking this action, VAFB officials will complete all relevant regulatory processes, and subsequently abide by all permit conditions and mitigations.

FINDING OF NO SIGNIFICANT IMPACT

Based upon my review of the facts and analyses contained in the attached EA, conducted in accordance with the provisions of NEPA, the CEQ Regulations, and 32 CFR Part 989, I conclude that the Proposed Action should not have a significant environmental impact, either by itself or cumulatively with other projects at VAFB. Accordingly, an Environmental Impact Statement is not required. The signing of this Finding of No Significant Impact and Finding of No Practicable Alternative completes the environmental impact analysis process.

FINAL DRAFT

**FINDING OF NO SIGNIFICANT IMPACT and
FINDING OF NO PRACTICABLE ALTERNATIVE
CONCURRENCE PAGE**

**In Conjunction with Final Environmental Assessment for the San Antonio Creek
Restoration at Vandenberg Air Force Base, California**

Environmental, Safety, and Occupational Health Council Approval:

STEPHEN M. TANOUS
Colonel, USAF
Chairman, Environmental, Safety,
and Occupational Health Council
Vandenberg AFB, CA

Date

MAJCOM Approval:

CHRIS PUCKETT, SES, DAF
Director of Installations and
Logistics

Date

Final Draft Environmental Assessment

San Antonio Creek Restoration

Vandenberg Air Force Base California

Prepared for:

Department of the Air Force
30th Space Wing Civil Engineer Squadron Environmental Flight
Vandenberg Air Force Base, California

27 June 2008

Contents

Table of Contents.....	i
List of Figures	iv
List of Tables.....	iv
Acronyms and Abbreviations	v

Table of Contents

Chapter 1. Purpose of and Need for the Proposed Action.....	1-1
1.1 Project Location.....	1-1
1.2 Background	1-1
1.3 Purpose of the Proposed Action.....	1-4
1.4 Need for the Proposed Action	1-4
1.5 Scope of the Environmental Assessment.....	1-4
1.6 Applicable Regulatory Requirements	1-5
Chapter 2. Description of the Proposed Action and Alternatives	2-1
2.1 Proposed Action (Alternative A)	2-1
2.1.1.1 Temporary Construction Access Roads, Staging Areas, and Operations within the Creek Bed	2-3
2.1.1.2 Containment of Creek Flow	2-3
2.1.1.3 Excavated Soil	2-3
2.1.1.4 Branch Cuttings	2-4
2.1.1.5 Restoration of Vegetation Types	2-4
2.1.1.6 Granular Filter.....	2-6
2.1.1.7 Project Equipment Needs.....	2-6
2.1.1.8 Construction Requirements	2-7
2.1.1.9 Grade Controls	2-7
2.1.1.10 Bank Stabilization Site 1	2-8
2.1.1.11 Bank Stabilization Site 2.....	2-9
2.1.1.12 Bank Stabilization Site 3.....	2-11
2.1.2 Post-Construction Monitoring and Maintenance	2-12
2.2 Alternative B: No-Action Alternative	2-12
2.3 Other Alternatives Considered and Eliminated from Further Analysis	2-12
2.3.1 Alternative C	2-12
2.3.2 Alternatives D through G	2-12
2.3.2.1 Alternative D	2-12
2.3.2.2 Alternative E	2-13
2.3.2.3 Alternative F	2-13
2.3.2.4 Alternative G.....	2-13
2.3.2.5 Alternative H	2-13
Chapter 3. Affected Environment	3-1
3.1 Air Quality.....	3-1
3.1.1 Regional Climate and Meteorology.....	3-1
3.1.2 Existing Air Quality.....	3-3
3.2 Biological Resources.....	3-4

3.2.1	Methodology	3-4
3.2.2	Vegetation Types	3-5
3.2.3	Wildlife Species	3-8
3.2.4	Special Status Species	3-9
3.2.5	Other Species Considered	3-12
3.2.6	Waters of the United States and Wetlands	3-12
3.3	Cultural Resources	3-12
3.3.1	Cultural Resource Studies	3-13
3.3.2	Recorded Cultural Resources	3-15
3.4	Earth Resources	3-17
3.4.1	Geology and Soils	3-17
3.4.2	Seismology	3-18
3.4.3	Geological Hazards	3-18
3.5	Hazardous Materials and Waste Management	3-19
3.5.1	Hazardous Materials Management	3-19
3.5.2	Hazardous Waste Management	3-19
3.5.3	Installation Restoration Program	3-20
3.6	Human Health and Safety	3-20
3.6.1	Public Safety	3-20
3.6.2	Worker Safety	3-20
3.6.3	Noise	3-21
3.6.4	Unexploded Ordnance	3-23
3.7	Land Use and Aesthetics	3-23
3.8	Transportation	3-24
3.9	Water Resources	3-25
3.9.1	Surface Water	3-27
3.9.2	Sediment	3-27
3.9.3	Floodplain	3-27
3.9.4	Hydraulics	3-27
3.9.5	Groundwater	3-29
3.9.6	Water Quality	3-29
Chapter 4.	Environmental Consequences	4-1
4.1	Air Quality	4-1
4.1.1	Proposed Action	4-1
4.1.2	Environmental Protection and Monitoring Measures	4-2
4.1.3	No-Action Alternative	4-3
4.2	Biological Resources	4-3
4.2.1	Proposed Action	4-3
4.2.1.1	Botanical Resources	4-4
4.2.1.2	Wildlife Species	4-5
4.2.1.3	Sensitive Vegetation Types and Special Status Species	4-6
4.2.1.4	Waters of the United States and Wetlands	4-8
4.2.2	Environmental Protection and Monitoring Measures	4-8
4.2.3	No-Action Alternative	4-10
4.3	Cultural Resources	4-10
4.3.1	Proposed Action	4-10
4.3.2	Environmental Protection and Monitoring Measures	4-12
4.3.3	No-Action Alternative	4-13
4.4	Earth Resources	4-13
4.4.1	Proposed Action	4-13

4.4.2	Environmental Protection and Monitoring Measures	4-13
4.4.3	No-Action Alternative	4-13
4.5	Hazardous Materials and Waste Management	4-13
4.5.1	Proposed Action	4-14
4.5.2	Environmental Protection and Monitoring Measures	4-14
4.5.3	No-Action Alternative	4-15
4.6	Human Health and Safety	4-15
4.6.1	Proposed Action	4-15
4.6.2	Environmental Protection and Monitoring Measures	4-16
4.6.3	No-Action Alternative	4-16
4.7	Land Use and Aesthetics	4-16
4.7.1	Proposed Action	4-16
4.7.2	Environmental Protection and Monitoring Measures	4-17
4.7.3	No-Action Alternative	4-17
4.8	Transportation	4-17
4.8.1	Proposed Action	4-17
4.8.2	Environmental Protection and Monitoring Measures	4-18
4.8.3	No-Action Alternative	4-18
4.9	Water Resources.....	4-18
4.9.1	Proposed Action	4-18
	4.9.1.1 Surface Water.....	4-19
	4.9.1.2 Sediment	4-19
	4.9.1.3 Floodplain	4-20
	4.9.1.4 Hydraulics.....	4-20
	4.9.1.5 Groundwater.....	4-20
4.9.2	Environmental Protection and Monitoring Measures	4-20
4.9.3	No-Action Alternative	4-21
4.10	Cumulative Impacts.....	4-21
Chapter 5.	Persons and Agencies Contacted	5-1
Chapter 6.	List of Preparers.....	6-1
Chapter 7.	Distribution List.....	7-1
Chapter 8.	Bibliography	8-1

Appendices

Appendix A – Engineering Plan Views and Typical Details

Appendix B – Air Quality Analysis

Appendix C – Biological Resources

Appendix D – Wetland Delineation

Appendix E – Cultural Resources

List of Figures

Figure 1-1. Regional location of VAFB.....	1-2
Figure 1-2. Proposed project areas and vicinity.....	1-3
Figure 2-1. Proposed restoration sites.....	2-2
Figure 2-2. Area proposed for willow collection outside the boundaries of the Proposed Action.....	2-5
Figure 3-1. Vegetation types within the proposed project area.....	3-6
Figure 3-2. Main access and transportation routes associated with the Proposed Action.....	3-26
Figure 3-3. San Antonio Creek 100-year floodplain.....	3-28

List of Tables

Table 1-1. Federal and state regulations applicable to the implementation of the Proposed Action.....	1-6
Table 2-1. Native plant species to be collected for pole and branch plantings.	2-4
Table 2-2. Native seed mixes to be used in revegetation efforts.	2-6
Table 2-3. Equipment needs for creek restoration.....	2-7
Table 3-1. Ambient air quality standards.	3-2
Table 3-2. Existing emissions.	3-3
Table 3-3. VAFB annual emissions (tons) in 2006.....	3-4
Table 3-4. Vegetation types found within the proposed restoration area on VAFB.	3-5
Table 3-5. Special status plant and wildlife species within the proposed project area.	3-9
Table 3-6. Previous cultural resource studies within one mile of the proposed project area.	3-14
Table 3-7. Previously recorded resources within and adjacent to the archaeological study areas.....	3-15
Table 3-8. Comparative A-weighted sound levels.	3-22
Table 3-9. Noise levels of heavy construction equipment.....	3-23
Table 3-10. Peak flow rates at San Antonio Road West Bridge.	3-27
Table 3-11. Peak flows of San Antonio Creek at the San Antonio Road West Bridge from February 1998 to March 2003.	3-27
Table 4-1. Potential Proposed Action related effects on special status species.....	4-4
Table 4-2. Partial list of projects for which NEPA analysis has been completed in the previous 5 years.	4-22

Acronyms and Abbreviations

%	Percent
°C	Degrees Celsius
µg/m ³	Micrograms per cubic meter
30 CES	30th Civil Engineer Squadron
30 CES/CC	30th Civil Engineer Squadron, Commander
30 CES/CD	30th Civil Engineer Squadron, Deputy Commander
30 CES/CEV	30th Civil Engineer Squadron, Environmental Flight
30 MDOS/SGOAB	30th Medical Operations Squadron, Bioenvironmental Engineering Element
30 SW	30th Space Wing
30 SWP	30th Space Wing Plan
30 SW/SE	30th Space Wing, Safety Office
A.D.	Anno Domini
AFI	Air Force Instruction
AFOSH	Air Force Occupational Safety and Health
Air Force	United States Air Force
AOC	Area of Concern
AOI	Area of Interest
Aspen	Aspen Environmental Group and Simons, Li and Associates
Base	Vandenberg Air Force Base
Basin Plan	Central Coast Regional Water Quality Control Board Water Quality Control Plan
B.C.	Before Christ
BCC	Federal Bird of Conservation Concern
BMP	Best Management Practice
Caltrans	California Department of Transportation
CAA	Clean Air Act
CAAQS	California Ambient Air Quality Standards
CARB	California Air Resources Board
CCR	California Code of Regulations
CDFG	California Department of Fish and Game
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	Cubic feet per second
CHP	California Highway Patrol
cm	Centimeter
CMP	Corrugated Metal Pipe
CO	Carbon monoxide
CSC	California Species of Concern
CWA	Clean Water Act
dB	Decibel
dBA	A-weighted decibel
DO	Dissolved oxygen
EA	Environmental Assessment
EO	Executive Order
EOD	Explosive Ordnance Disposal
EPA	Environmental Protection Agency
EPP	Environmental Protection Plan

ESA	Endangered Species Act
FE	Federal Endangered Species
FEMA	Federal Emergency Management Agency
FONPA	Finding of No Practicable Alternative
FONSI	Finding of No Significant Impact
ft	Feet
FT	Federal Threatened Species
GPS	Global Positioning System
GIS	Geographic Information System
HDR	HDR Engineering, Inc.
H:V	Horizontal:Vertical
H ₂ S	Hydrogen sulfide
HazMart	Hazardous Materials Pharmacy
Hwy	Highway
IRP	Installation Restoration Program
L _{eq1H}	One-hour average sound level
lbs	Pounds
lbs/day	Pounds per day
LOS	Level of Service
m	meter
mg/L	Milligrams per liter
mi	Mile
mi ²	Square mile
MILCON	Military construction
MOA	Memorandum of Agreement
mm Hg	Millimeters of mercury
mph	Miles per hour
MSRS	ManTech SRS Technologies, Inc.
NAAQS	National Ambient Air Quality Standards
NCA	Noise Control Act
NCHRP	National Cooperative Highway Research Program
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NO ₂	Nitrogen dioxide
NO _x	Nitrogen oxides
NOAA Fisheries Service	National Oceanic and Atmospheric Administration National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System
NRHP	National Register of Historic Places
O ₃	Ozone
O&M	Operations and maintenance
OHWM	Ordinary high water mark
OSHA	Occupational Safety and Health Administration
Pb	Lead
PM _{2.5}	Particulate matter 2.5 microns or less in diameter
PM ₁₀	Particulate matter 10 microns or less in diameter
POL	Petroleum, oil and lubricant
ppm	Parts per million
RCRA	Resource Conservation and Recovery Act
ROC	Reactive Organic Compound
RWQCB	Regional Water Quality Control Board

SAIC	Science Applications International Corporation
SBCAPCD	Santa Barbara County Air Pollution Control District
SCAQMD	South Coast Air Quality Management District
SE	California Endangered Species
SEL	Sound exposure level
SHPO	State Historic Preservation Officer
SO ₂	Sulfur dioxide
SO ₄	Sulfates
SR	State Route
SRS	SRS Technologies, Inc.
SWPPP	Storm Water Pollution Prevention Plan
SWRCB	State Water Resources Control Board
TDS	Total dissolved solid
tons/yr	Tons per year
TSS	Total suspended solids
UCSB	University of California, Santa Barbara
U.S.	United States
USACE	United States Army Corps of Engineers
USAF	United States Air Force
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
VAFB	Vandenberg Air Force Base
VMSE	Vegetated mechanically stabilized earth
VOC	Volatile organic compound
WDR	Waste Discharge Requirement
yd ³	Cubic yard

[This page intentionally left blank.]

Chapter 1. Purpose of and Need for the Proposed Action

This Environmental Assessment (EA) evaluates the potential environmental consequences of restoring 0.875 mile (mi) of San Antonio Creek on Vandenberg Air Force Base (VAFB or Base), California. The National Environmental Policy Act (NEPA) and the Council on Environmental Quality (CEQ) regulations require lead agencies to evaluate the potential impacts of federal actions on the human environment. The United States (U.S.) Air Force (Air Force or USAF) is the lead agency for NEPA compliance on the proposed project.

This EA has been prepared in accordance with the NEPA of 1969, as amended (42 U.S. Code [U.S.C.] 4321 et seq.); as implemented by CEQ Regulations (40 Code of Federal Regulations [CFR] Parts 1500-1508); and 32 CFR Part 989.

1.1 Project Location

VAFB is headquarters for the 30th Space Wing (30 SW). The Air Force's primary missions at VAFB are to launch and track satellites in space, to test and evaluate America's intercontinental ballistic missile systems, and support aircraft operations in the Western Range. As a non-military facet of operations, VAFB is also committed to promoting commercial space launch ventures.

VAFB is located on the south-central coast of California, approximately halfway between San Diego and San Francisco (Figure 1-1). The Base covers approximately 99,000 acres in western Santa Barbara County (VAFB 2007), and occurs in a transitional ecological region that includes the northern and southern distributional limits for many plant and animal species.

The proposed project area is located within the San Antonio Creek watershed between Highway (Hwy) 1 and the El Rancho Lateral Road-Lompoc Casmalia Road intersection. Figure 1-2 illustrates the regional location of the project area. San Antonio Creek is a 28-mile long, east-west trending creek, entering north VAFB at Barka Slough, on its eastern boundary, approximately 2 mi west of the San Antonio Road East/State Route (SR) 135 interchange and emptying into the Pacific Ocean north of Purisima Point. The San Antonio Creek drainage basin is an elongated basin encompassing approximately 154 square miles (mi²) that includes Los Alamos Valley in the upstream portion and San Antonio Valley in the downstream portion. Although intermittent through much of its course, the creek is perennial west of Barka Slough. The creek exists in a fairly natural condition along its entire length. It flows through the bottom of the valley with a meandering channel lined with riparian vegetation. Although the creek's flow is generally sluggish west of Barka Slough, San Antonio Creek is an actively changing watercourse that is often deeply entrenched 15 feet (ft) or more.

1.2 Background

San Antonio Creek is actively adjusting its profile and channel geometry between Barka Slough and Lompoc-Casmalia Road, and has experienced significant erosion (degradation), deposition (aggradation), channel widening, and bend migration in recent years. Studies completed in this reach of the creek (Aspen Environmental Group and Simons, Li and Associates [Aspen] 1998; Tetra Tech 2000, 2002; U.S. Army Corps of Engineers [USACE] 2004; HDR Engineering, Inc. [HDR] 2006)

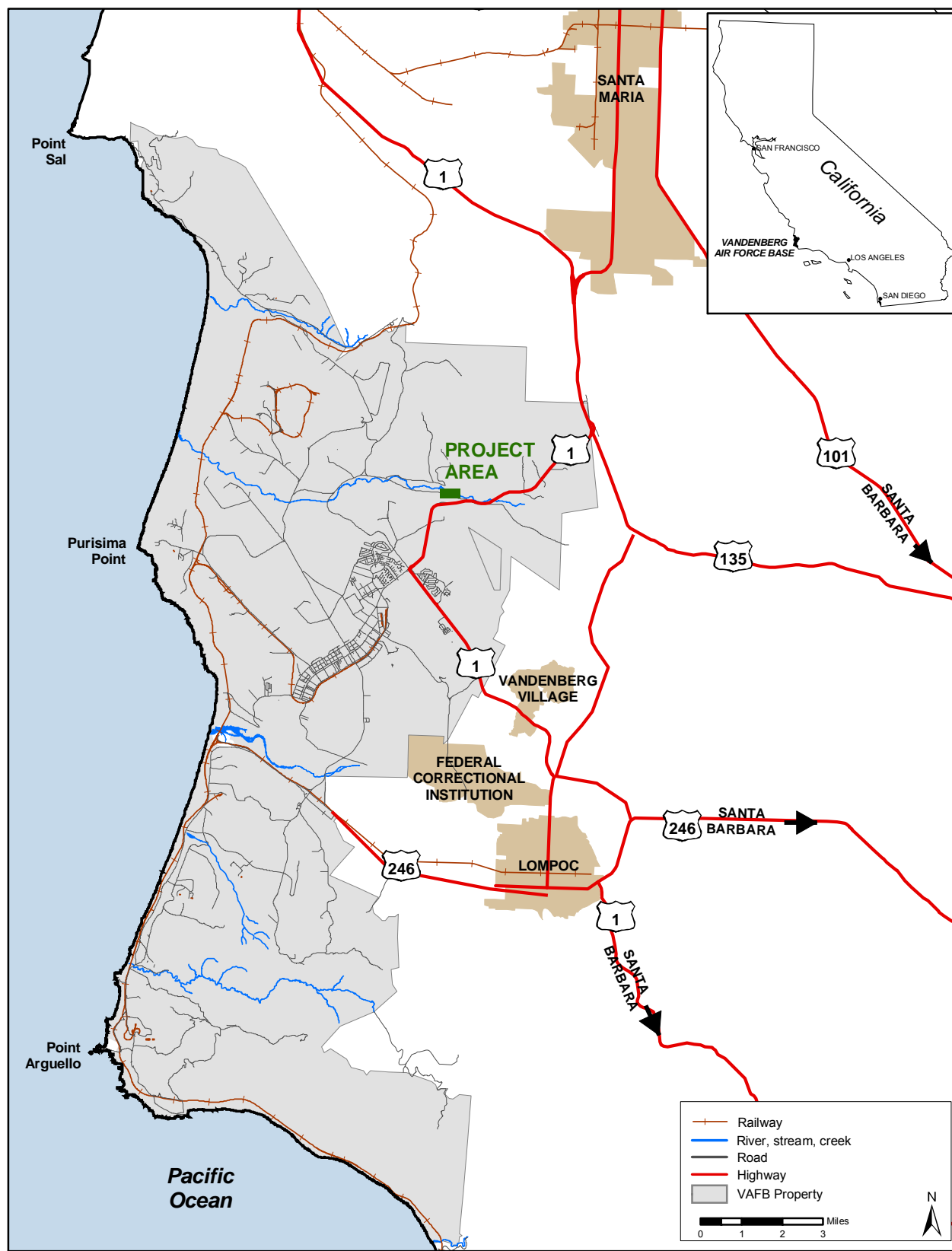


Figure 1-1. Regional location of VAFB.

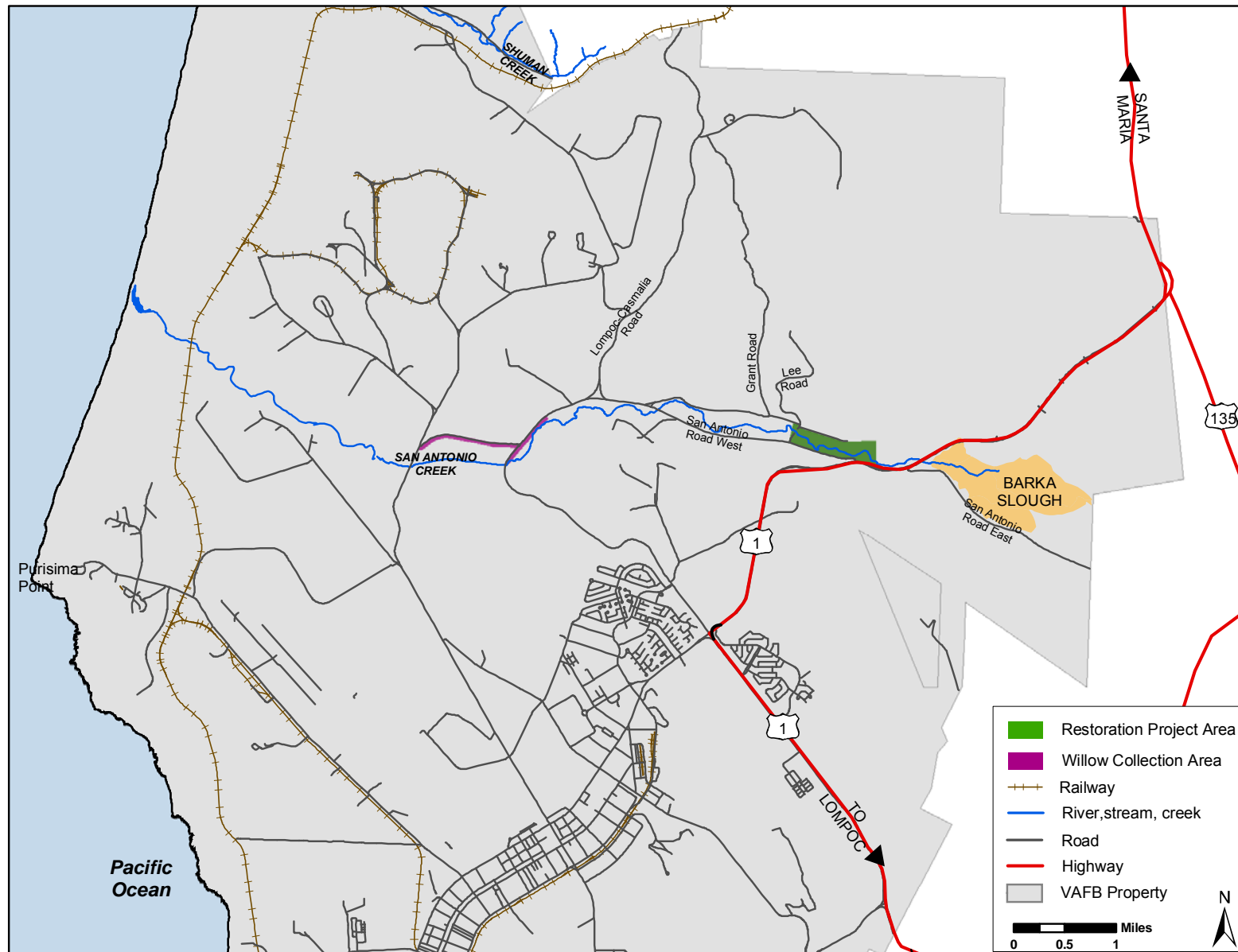


Figure 1-2. Proposed project areas and vicinity.

indicate that this trend is expected to continue. The effects of this instability have led to a degraded stream channel environment, and hydrologic disconnection of the stream from the surrounding floodplain. In addition, local infrastructure such as utilities, a highway, and roads are threatened.

Storm flows in February 1998 caused erosion damage in several areas along San Antonio Creek, between Hwy 1 and the Lee Road Utility Bridge, as well as a tributary to the creek, threatening roadways, a bridge structure, and utility lines. Emergency repairs to three sites were performed in late February and early March of 1998 to protect threatened facilities.

The emergency repairs performed at the San Antonio Road West-Creek Bend and Lee Road Utility Bridge sites are not considered adequate to provide long-term protection against bank erosion. The emergency nature of the repairs prevented the use of more durable construction methods, such as embedding riprap below the surface of the stream bed, properly compacting fill material, securely placing the riprap on the bank slopes, and installing geotextile fabric underneath the riprap to help prevent erosion of the underlying soil. Additional protection is needed at these sites to prevent the toe of the bank from being undermined by anticipated heavy flows during future storms.

The San Antonio Road West-Creek Bend Site sustained erosion along a bend in the stream course that caused the southern bank of the channel to migrate into the roadway embankment. Further undercutting of the embankment during future storms could undermine the roadway, causing the closure of San Antonio Road West. San Antonio Road West links Hwy 1 and Lompoc-Casmalia Road, and provides critical access to facilities on north VAFB. The Lee Road Utility Bridge supports a water line that carries water from remote well locations to the water treatment facility on San Antonio Road West. A second water line carries treated water back across the bridge to facilities on VAFB, north of San Antonio Creek.

1.3 Purpose of the Proposed Action

VAFB proposes to remediate extensive damage to the banks and stream channel caused by heavy storm flows to this reach of San Antonio Creek, which has resulted in severe scouring and erosion, particularly in the area between Barka Slough and the downstream crossing of San Antonio Road West. Over time, this reach of the creek has become entrenched within a deeply incised channel. Scouring from storm flows has gradually lowered the bed of the channel and bank erosion has produced steep channel walls. The goals of the proposed restoration are to restore hydrologic function, enhance stream stability, minimize potential for further erosion, protect several creek embankments, and begin to return channel morphology to a proper functioning condition.

1.4 Need for the Proposed Action

Under present conditions, eventual collapse of several creek embankments near Hwy 1 is unavoidable, which would cause: failure of San Antonio Road West and the Lee Road Utility Bridge, severing vital transportation and utility links to north VAFB; impacts to space launch missions; and, potential loss of life and mission assets. Long detours would be required for all traffic, causing considerable delay and loss of productivity for personnel working on north VAFB, and incurring additional costs for permitting and transport of hazardous cargoes.

1.5 Scope of the Environmental Assessment

Consistent with Title 32 CFR Part 989, and CEQ regulations (40 CFR 1500-1508), the scope of analysis presented in this EA is defined by the potential range of environmental impacts resulting from implementing the Proposed Action and Alternatives. Pursuant to 40 CFR Part

1501.4(c), resources potentially impacted are considered in more detail to provide sufficient evidence and analysis to determine whether or not to prepare an environmental impact statement. This EA identifies, describes, and evaluates the potential environmental impacts that could result from the Proposed Action and No-Action Alternative. No other alternatives were deemed feasible due to potential adverse effects to natural and cultural resources.

This EA also considers and evaluates possible cumulative impacts from other past, present, and planned actions on VAFB. In addition, the EA identifies environmental permits relevant to the Proposed Action. As appropriate, the EA describes, in terms of a regional overview or a site-specific description, the affected environment and environmental consequences of the Proposed Action, and identifies measures to prevent or minimize environmental impacts.

Because the Proposed Action would occur within the 100-year floodplain of San Antonio Creek, as defined by the Federal Emergency Management Agency (FEMA), and within a wetland, no practicable alternative to the Proposed Action is possible. All other alternatives considered would also occur within a wetland and were dismissed due to significant impacts as described in Chapter 2. Per 32 CFR Part 989, and Executive Orders (EOs) 11988 and 11990, a Finding of No Significant Impact/Finding of No Practicable Alternative (FONSI/FONPA) must be prepared.

Resources analyzed in this EA include air quality; biological resources; cultural resources; earth resources; hazardous materials and hazardous waste management; human health and safety; land use and aesthetics; noise; transportation; and water resources. The following resources were considered but not analyzed in this EA:

► *Environmental Justice.* Per EO 12898, *Environmental Justice*, the potential effects of the Proposed Action on minority communities

and low-income communities were considered. Because the Proposed Action and any potential effects would occur within VAFB boundaries, it would not affect low income or minority populations within the region (Lompoc and Santa Maria Valleys).

► *Socioeconomics.* The short-term nature (approximately 7 to 10 weeks) and the minimal manning (approximately 30 to 40 workers) associated with the Proposed Action would not affect the socioeconomic conditions of the region (Lompoc and Santa Maria Valleys).

► *Solid Waste Management.* It is anticipated that minimal amounts of solid waste would be generated during project implementation. No demolition or deconstruction debris would be generated. All activities associated with the Proposed Action would be performed in accordance with VAFB's *Pollution Prevention Management Plan*. In addition, while only minimal amounts of solid waste are anticipated to be generated from the Proposed Action, solid waste from the project would be minimized by strict compliance with applicable federal and state statutes and regulations, as well as by following requirements contained in the 30 SW Plan (SWP) 32-7042, *Solid Waste Management Plan*. Solid waste generated during project activities would be disposed of in the VAFB Sanitary Landfill or taken off Base property for recycling or disposal.

A list of acronyms and abbreviations used in this EA is included after the Table of Contents.

1.6 Applicable Regulatory Requirements

Federal and state regulations applicable to the Proposed Action and the No-Action Alternative are summarized in Table 1-1.

Table 1-1. Federal and state regulations applicable to the implementation of the Proposed Action.

Federal Regulation	Activity or Requirement
American Indian Religious Freedom Act of 1978 (42 U.S.C. 1996)	The American Indian Religious Freedom Act states that the policies and procedures of federal agencies must comply with the constitutional clause prohibiting abridgment of religious freedom—including freedom of belief, expression, and exercise—for Native Americans. The American Indian Religious Freedom Act policy is to consider Native American access to sites, use and possession of sacred objects, and freedom to worship, and directs federal agencies to revise policies and procedures to correct conflicts with Native American religious cultural rights and practices.
Archaeological and Historic Preservation Act of 1974 (16 U.S.C. 469a et seq.)	The Archaeological and Historic Preservation Act is directed toward the preservation of historic and archaeological data that would otherwise be lost as a result of federal construction or other federally licensed or assisted activities. The Archaeological and Historic Preservation Act authorizes the Department of the Interior to undertake recovery, protection, and preservation of archaeological or historic data.
Archaeological Resources Protection Act of 1979 (16 U.S.C. 470aa-mm), Supplemental Regulations of 1984	The Archaeological Resources Protection Act secures protection of archaeological resources and sites on public and Indian lands; requires permitting for any excavation or collection of archaeological material from these lands; and provides civil and criminal penalties for violations.
Clean Air Act of 1970 (42 U.S.C. 7401 et seq.)	The Clean Air Act states that applicable national ambient air quality standards must be maintained during the operation of any emission source. National Ambient Air Quality Standards include primary and secondary standards for various pollutants. The primary standards are mandated by the Clean Air Act to protect public health, while the secondary standards are intended to protect the public welfare from adverse impacts of pollution, such as visibility impairment.
Clean Air Act Amendments of 1990	These amendments establish new federal non-attainment classifications, new emissions control requirements, and new compliance dates for areas in non-attainment. The requirements and compliance dates are based on the non-attainment classification.
Clean Water Act of 1977 as amended (33 U.S.C. 1251 et seq.)	Prohibits the discharge of pollutants from a point source into navigable Waters of the US, except in compliance with a National Pollutant Discharge Elimination System (40 CFR Part 122) permit. Navigable Waters of the US are considered to encompass any body of water whose use, degradation, or destruction will affect interstate or foreign commerce. Section 404 of the Clean Water Act establishes a program to regulate the discharge of dredged and fill material into waters of the U.S., including wetlands. Activities in waters of the US that are regulated under this program include fills for development, water resource projects (such as dams and levees), infrastructure development (such as highways and airports), and conversion of wetlands to uplands for farming and forestry. Section 401 of the Clean Water Act requires that the discharge of dredged or fill material into water of the U.S. does not violate state water quality standards. Generally, no Clean Water Act Sec. 404 permits will be issued until the State has been notified and the applicant has obtained a certification of state water quality standards.
Coastal Zone Management Act of 1972 (16 U.S.C. 2452-24645).	The Coastal Zone Management Act plays a significant role in water quality management. Under the Act, a federal action that may affect the coastal zone must be carried out in a manner that is consistent with state coastal zone management programs.
Endangered Species Act of 1973 (7 U.S.C. 136; 16 U.S.C. 460 et seq.)	Declares the intention of Congress to conserve threatened and endangered species and the ecosystems on which these species depend. The Endangered Species Act requires that federal agencies, in consultation with the U.S. Fish and Wildlife Service and the National Oceanic and Atmospheric Administration National Marine Fisheries Service, use their authorities in furtherance of its purposes by carrying out programs for the conservation of endangered or threatened species.
Section 7 of the Endangered Species Act (16 U.S.C. 1536)	Contains provisions that require federal agencies to consult with the Secretary of Interior and to take necessary actions to ensure that actions authorized, funded, or carried out by them do not jeopardize the continued existence of endangered species and threatened species.
Energy Policy Act of 1992 as amended (42 U.S.C. 8256 et seq.)	The Energy Policy Act requires that federal agencies significantly reduce their use of energy and reduce environmental impacts by promoting the use of energy-efficient and renewable energy technologies.
Migratory Bird Treaty Act of 1918 as amended (16 U.S.C. 703-712)	The Migratory Bird Treaty Act implements various treaties and conventions between the United States and Canada, Japan, Mexico, and the former Soviet Union for the protection of migratory birds. Under the Act, taking, killing or possessing migratory birds is unlawful.

Federal Regulation	Activity or Requirement
National Environmental Policy Act of 1969 as amended (42 U.S.C. 4321-4347)	Requires federal agencies to analyze the potential environmental impacts of major federal actions and alternatives and to use these analyses as a decision-making tool on whether and how to proceed.
National Historic Preservation Act of 1966 as amended (16 U.S.C. 470 et seq.)	The National Historic Preservation Act is the key federal law establishing the foundation and framework for historic preservation in the U.S. The Act authorizes the Secretary of the Interior to expand and maintain a National Register of Historic Places, establishes an Advisory Council on Historic Preservation as an independent federal entity; requires federal agencies to take into account the effects of their undertakings on historic properties, and to afford the Council an opportunity to comment upon any undertaking that may affect properties listed, or eligible for listing, in the Register; and makes the heads of all federal agencies responsible for the preservation of historic properties owned or controlled by them.
Native American Graves Protection and Repatriation Act of 1990 (25 U.S.C. 3001-3013)	The Native American Graves Protection and Repatriation Act restores certain rights to Native Americans with respect to the disposition of ancestral human remains and cultural objects; vests ownership of these materials (from federal or tribal lands) with designated Native American groups; requires notification of federal agency head when Native American cultural items are discovered on federal or tribal lands; prohibits trafficking in Native American human remains and cultural items; requires inventory and tribal notification of human remains and associated funerary objects held in existing collections by museums or federal agencies; and provides for repatriation of these materials.
Noise Control Act of 1972 (42 U.S.C. 4901 et seq.)	<p>The Noise Control Act establishes a national policy to promote an environment for all Americans free from noise that jeopardizes their health and welfare. To accomplish this, the Act establishes a means for the coordination of federal research and activities in noise control, authorizes the establishment of federal noise emissions standards for products distributed in commerce, and provides information to the public respecting the noise emission and noise reduction characteristics of such products.</p> <p>The Act authorizes and directs that federal agencies, to the fullest extent consistent with their authority under federal laws administered by them, carry out the programs within their control in such a manner as to further the policy declared in 42 U.S.C. 4901. Each department, agency, or instrumentality of the executive, legislative and judicial branches of the federal government having jurisdiction over any property or facility or engaged in any activity resulting, or which may result in, the emission of noise shall comply with federal, state, interstate, and local requirements respecting control and abatement of environmental noise.</p>
Occupational Safety and Health Act of 1970 (29 U.S.C. 659-678)	The Occupational Safety and Health Act was established to assure safe and healthful working conditions for working men and women by: authorizing enforcement of the standards developed under the Act; by assisting and encouraging the states in their efforts to assure safe and healthful working conditions; by providing for research, information, education, and training in the field of occupational safety and health; and for other purposes.
Pollution Prevention Act of 1990	The Pollution Prevention Act establishes that pollution should be prevented or reduced at the source whenever feasible; pollution that cannot be prevented should be recycled in an environmentally safe manner, whenever feasible; pollution that cannot be prevented or recycled should be treated in an environmentally safe manner whenever feasible; and that disposal or other release into the environment should be employed only as a last resort and should be conducted in an environmentally safe manner.
Resource Conservation and Recovery Act of 1976 (42 U.S.C. 6901 et seq.)	The Resource Conservation and Recovery Act gives the U.S. Environmental Protection Agency the authority to control hazardous waste from the "cradle-to-grave." This includes the generation, transportation, treatment, storage, and disposal of hazardous waste. The Act also sets forth a framework for the management of non-hazardous wastes.
State Regulation	Activity or Requirement
California Coastal Act of 1976	The California Coastal Act provides long-term protection of California's 1,100-mile coastline for the benefit of current and future generations. Coastal Act policies constitute the standards used by the Coastal Commission in its coastal development permit decisions and for the review of local coastal programs prepared by local governments and submitted to the Commission for approval. These policies are also used by the Commission to review federal activities that affect the coastal zone.

State Regulation	Activity or Requirement
Clean Air Act of 1988	The Clean Air Act develops and implements a program to attain the California Ambient Air Quality Standards for ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, particulate matter less than or equal to 10 microns in diameter, lead, sulfates, hydrogen sulfide, and vinyl chloride. 40 CFR Part 51 gives state and local agencies the authority to establish air quality rules and regulations. Rules adopted by the local air pollution control districts and accepted by the Air Resources Board are included in the State Implementation Plan. When approved by the U.S. Environmental Protection Agency, these rules become federally enforceable.
Porter-Cologne Water Quality Control Act	Protects all waters of the state for the use and enjoyment of the people of California and declares that the protection of water resources be administered by the regional water quality control boards.
California Integrated Waste Management Act of 1989, California Assembly Bill AB 939	Provides for the proper management and disposal of solid wastes, to include the diversion requirements for construction and demolition debris.

Chapter 2. Description of the Proposed Action and Alternatives

This chapter describes the Proposed Action, the No-Action Alternative, and other identified Alternatives. The chapter provides detailed descriptions of equipment needs, construction requirements, and operational parameters, for the restoration of San Antonio Creek under the Proposed Action. These descriptions are based on the *San Antonio Creek Stream Restoration, Basis of Design Report*, dated February 22, 2008 (HDR 2008).

2.1 Proposed Action (Alternative A)

Under the Proposed Action, approximately 0.875 mi of San Antonio Creek, between Hwy 1 and the Lee Road Utility Bridge (Figure 2-1), would be restored to protect creek banks from erosion and potential failure, and to maintain a desired streambed elevation to reduce channel erosion and promote channel stability. These measures would also increase in-stream habitat and improve water quality.

The specific objectives of this restoration project are to:

- ▶ Protect local infrastructure.
- ▶ Provide grade stabilization and prevent further channel lowering (degradation).
- ▶ Prevent migration of channel bottom headcuts through the restoration area.
- ▶ Reduce the potential for undermining the Lee Road Utility Bridge structure.
- ▶ Decrease water velocity and shear stress during flood events by increasing flow area at bends within the restoration area.
- ▶ Provide habitat diversity by restoring historical flood terraces within the restoration area.
- ▶ Increase the quality of suitable habitat within the restoration area for the federally

endangered unarmored threespine stickleback (*Gasterosteus aculeatus williamsoni*), the federally threatened California red-legged frog (*Rana aurora draytonii*), and other wildlife species.

- ▶ Stabilize the creek bank in key areas.
- ▶ Reduce erosion and quantity of sediment delivered to downstream wetlands.

The restoration would entail constructing two integrated components within San Antonio Creek:

1) ***In-stream rock-riffle grade controls at seven sites.*** Grade controls are designed to stabilize channel invert. The National Cooperative Highway Research Program Report 544, *Environmentally Sensitive Channel- and Bank- Protection Methods* (Transportation Research Board 2005), identifies in-stream rock-riffles as an “environmentally sensitive” method of grade control. Rock riffles would prevent aggressive bed degradation from occurring, and arrest existing headcuts from continuing upstream.

2) ***Bioengineering bank stabilization at three of the grade control sites.*** This includes:

- ▶ *Longitudinal Peak Stone Toe Protection* - consisting of continuous protection at the toe of the embankment, allowing stone to self adjust into scour holes that may form.
- ▶ *Live Siltation* – consisting of live branch cuttings at the toe of the slope, extending below the seasonal saturation zone, and angling toward the creek channel. This method adds strength to the toe, increases bank roughness that encourages sediment deposition and reduces bank erosion, provides vegetative cover, and creates riparian habitat.
- ▶ *Floodplain Terraces* - appropriate where the natural floodplain has been cut off from the channel due to incision of the channel

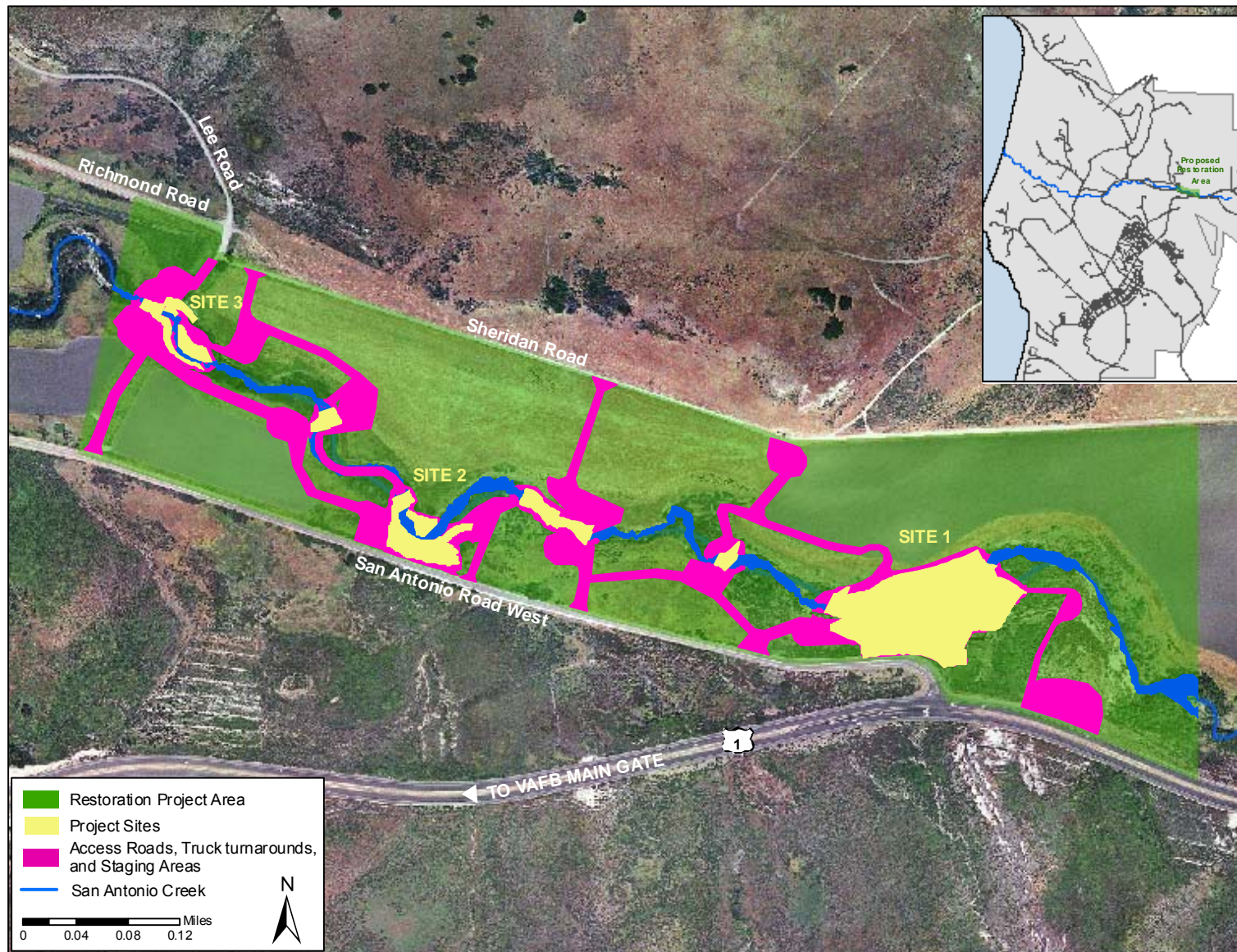


Figure 2-1. Proposed restoration sites.

over time. Recreated floodplain terraces dissipate energy during high creek flows, creating floodwater and sediment storage areas, and increasing conveyance capacity. These terraces should reduce pressure from the southern bank, where erosion susceptibility is high.

Engineering plan views of these structures and typical details are depicted in Appendix A. The estimated total project area is 127.84 acres.

2.1.1.1 Temporary Construction Access Roads, Staging Areas, and Operations within the Creek Bed

Temporary access roads would be constructed throughout the restoration area to access and deliver construction materials to project sites (Figure 2-1). These access roads would range from approximately 200 to 800 ft in length, and have a 15-foot wide base.

Areas for equipment turn-around and staging of materials would be located adjacent to the access roads. Construction materials to be stockpiled in these areas include excavated soil, stone aggregates, and rock riprap. An existing graded area located on the westbound shoulder of Hwy 1, east of San Antonio Road West, would also be used for staging equipment and materials. The rock would be placed individually to ensure a stable surface that provides protection for the creek bed and banks. A crane would place rock from the top of the embankment when possible. An excavator would operate from the creek bed and banks to place the remainder of the rock.

Existing vegetation (mostly disturbed Central Coast Scrub dominated by coyote brush [*Baccharis pilularis*]) would be removed to clear access roads and staging areas. Vegetative material would be processed into smaller pieces, and incorporated into mulch for use within the project area. To the extent feasible, vegetation would be removed mechanically. Large woody vegetation would be hand cleared within sensitive cultural resources areas, leaving root systems intact.

Smaller vegetation would be crushed during construction of the roads and staging areas.

Access roads and staging areas would be graded and compacted where required. Woven geotextile fabric would be laid out, and a 6- to 8-inch thick layer of small diameter rock placed on top to prevent soil compaction and increase stability, if needed. The rock and geotextile fabric would be removed upon completion of the project. To the maximum extent feasible, all temporary access roads and staging areas would be restored to their original condition.

2.1.1.2 Containment of Creek Flow

Temporary containment of the active creek channel would be necessary to ensure unimpeded flow and prevent flowing water from flooding excavation sites. Impounding the channel upstream of a project site boundary, and installing 4- to 6-inch corrugated plastic pipes, would allow active flows to pass through or around the project site. Screening would be placed at the intake of the water diversion pipes. Velocity dissipation would be provided at the outfall where the diverted creek is returned to its natural channel. Containment of the creek flow during work at each specific site would occur for a limited amount of time, until all equipment operations below the 2-year water elevation is complete (approximately 3 to 7 days per site). After completing project activities, the temporary pipes would be capped-off and remain buried in place.

2.1.1.3 Excavated Soil

The most desirable growth medium for native plants is native topsoil containing site-adapted seeds and microorganisms that contribute to the long-term establishment of revegetation plantings. Native topsoil and subsoil would be salvaged during excavation and grading, except in areas with a seed bank likely dominated by undesirable weed species. Soil excavated within the project area would be used as fill within project sites. Excess material would be transported to a designated waste or fill site.

2.1.1.4 Branch Cuttings

Biotechnical soil stabilization is a construction method that uses vegetative material and structural components in a mutually reinforcing manner. Biotechnical plantings would be incorporated during construction to provide geotechnical strength, improved habitat, enhanced aesthetics, and promote rapid revegetation. Willows (*Salix* spp.), the dominant riparian tree species within the project area, and other species native to the San Antonio Creek watershed that propagate rapidly from cuttings, would be used for biotechnical stabilization and bioengineering. To maintain genetic integrity, cuttings would be collected from species growing within the project area. If additional cuttings are needed, collection would occur within approximately 22.35 acres of willow riparian habitat near the El Rancho Lateral Road-Lompoc Casmalia Road intersection (Figure 2-2).

Live branch cuttings, predominantly willow, would be separated into two categories: branches (6 to 10 ft), and poles (greater than 10 ft). Branch cuttings would be used for live siltation and horizontal brush-layering techniques, arrayed depending on their desired function and site condition. Poles would be used to vegetate rock riprap. Table 2-1 lists native plant species planned for use in pole and bundle plantings. This list comprises the majority of arboreal species occurring naturally within the VAFB portion of the San Antonio Creek watershed (Keil and Holland 1998). Branches would be conservatively collected so the parent plant is not compromised.

Branches and poles would be collected using chain or handsaws. Cuttings would be collected at least 24 hours prior to planting, and soaked until planted. Live branch materials would be watered-in after installation.

Table 2-1. Native plant species to be collected for pole and branch plantings.

Scientific Name	Common Name
<i>Populus balsamifera</i> ssp. <i>trichocarpa</i>	Black cottonwood
<i>Salix laevigata</i>	Red willow
<i>Salix lasiolepis</i>	Arroyo willow
<i>Salix lucida</i> ssp. <i>lasiandra</i>	Shining willow
<i>Sambucus mexicana</i>	Blue elderberry

2.1.1.5 Restoration of Vegetation Types

Areas disturbed by construction activities would be restored to an ecologically functional state that supports the same local plant and animal species found in adjacent natural areas. Native species were selected on the basis of providing conditions that facilitate soil deposition, nutrient cycling, plant succession, natural regeneration, wildlife movement, and erosion control.

All disturbed soil areas above the ordinary high water mark (OHWM) would receive a standard treatment that includes:

- ▶ Soil preparation, including surface roughening and tracking with mechanical equipment, to catch seed, fertilizer and mulch, and decrease runoff.
- ▶ Soil amendments, including mycorrhizae inoculum, organic fertilizer (Biosol® Mix 7-2-3 or equivalent), and a 2-inch layer of compost (if needed) to rebuild soil nutrients and biological soil structure, encourage native plant succession, and discourage invasive plant species.
- ▶ A seed mix and weed-free straw mulch for temporary cover, to aid in the establishment of vegetation. If necessary, a tackifier would be hydraulically applied to anchor the straw mulch.

Habitat specific seed mixes would accommodate for species variation within different vegetation types, with a combination of shrub, perennial, and annual species. Table 2-2 lists seed mixes that would be used in revegetation efforts for riparian and upland vegetation types. These commercially

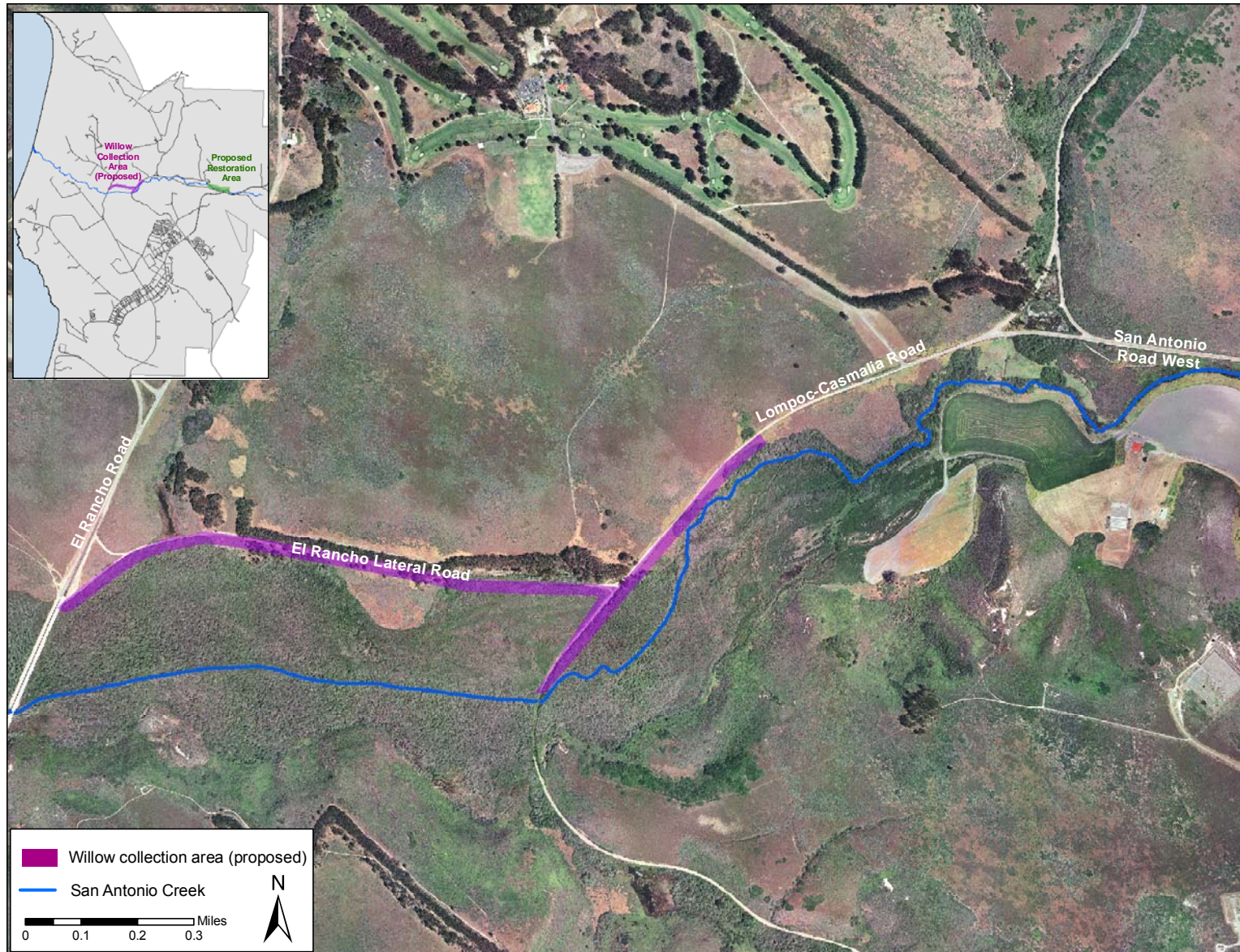


Figure 2-2. Area proposed for willow collection outside the boundaries of the Proposed Action.

Table 2-2. Native seed mixes to be used in revegetation efforts.

Common Name	Scientific Name	Application (lbs/acre)
Riparian		
Mugwort	<i>Artemisia douglasiana</i>	2
Mulefat	<i>Baccharis salicifolia</i>	2
Umbrella sedge	<i>Cyperus eragrostis</i>	1
Meadow barley	<i>Hordeum brachyantherum</i>	8
Creeping wild rye	<i>Leymus triticoides</i>	10
Small fescue	<i>Vulpia microstachys</i>	3
Upland		
Coyote bush	<i>Baccharis pilularis</i>	3
California brome	<i>Bromus carinatus</i>	5
California poppy	<i>Eschscholzia californica</i>	1
Toyon	<i>Heteromeles arbutifolia</i>	2
Goldfields	<i>Lasthenia glabrata</i>	1
Giant wild rye	<i>Leymus condensatus</i>	3
Dove lupine	<i>Lupinus bicolor</i>	3
Lompoc monkey flower	<i>Heteromeles arbutifolia</i>	2
Purple needlegrass	<i>Nassella pulchra</i>	5
Branching phacelia	<i>Phacelia ramosissima</i>	2
Blue elderberry	<i>Sambucus mexicana</i>	1
Western vervain	<i>Verbena lasiostachys</i>	2

available mixes were selected based on species reported in *Alternative Analysis Report San Antonio Creek Crossing Alternatives, Vandenberg Air Force Base, Volumes I and II* (USACE 1998), and *San Antonio Creek Short-term Flood Control Draft EA* (Tetra Tech 1997); and on information gathered during site visits conducted in 1998 by Aspen, and in 2005 and 2008 by ManTech SRS Technologies, Inc. (MSRS). It is anticipated that salvaged soils would also contain a seed bank, which would eventually increase species density and diversity. Seed mixes would be applied by uniformly spreading the seed mix by hand, and would be limited to the species and quantity specified in the seed mix.

In addition, *Juncus* spp. and *Carex* spp. divisions would be salvaged from the project area, or collected from Barka Slough (Figure

1-2), and planted in disturbed soil areas within the 2-year floodplain.

2.1.1.6 Granular Filter

In lieu of standard geotextiles, a 12-inch layer of granular filter, composed of a graded aggregate, would be used where appropriate, to encourage root establishment and biotechnical slope stabilization. Approximately 1,815 cubic yards (yd³) of granular filter would be used during project implementation.

2.1.1.7 Project Equipment Needs

Table 2-3 provides the estimated types of equipment that would be used for the proposed project. Although the exact type of equipment may vary slightly from these projections, these estimates provide a sound basis for analyzing related issues, such as air quality.

Table 2-3. Equipment needs for creek restoration.

Equipment	Task Description
Excavator	Excavate and place rock
Loader	Place materials
Chipper/Mulcher	Mulch
Water Truck	Provide portable water
Dump Trucks	Deliver materials
Road Grader	Clear access
Dozer	Grade
Compactor	Compact soil
Forklift	Unload materials
Crane	Move and place rock
Chainsaw	Remove vegetation
Crew truck	Transport workers to site

2.1.1.8 Construction Requirements

Implementation of the proposed restoration project would last approximately 7 to 10 weeks. Construction activities would begin approximately August 25, 2008, and end October 15, 2008. If rains begin prior to project completion, activities would resume in the spring of 2009. Project activities would occur within 8- to 10-hour workdays, and 5- to 6-day workweeks. Two teams of approximately six workers and a construction supervisor would participate in construction activities. However, at any one time, approximately 30 to 40 personnel could be present working on different aspects of the restoration. Traffic on San Antonio Road West would be restricted to one lane within the project area for approximately 15 days.

2.1.1.9 Grade Controls

Rock-riffle grade controls would be installed at seven locations in San Antonio Creek from just below bank stabilization Site 1 (see description below) to just below the Lee Road Utility Bridge, with a typical spacing of 500 to 930 ft (Figure 2-1). The locations and elevations for these structures were selected based on the anticipated future channel profile, and to tie into bank stabilization sites.

Access to all grade control structures would be restricted to designated access routes (Section 2.1.1.1) originating from Sheridan Road, San Antonio Road West, and Lee Road.

Grade control structure No. 1 is particularly important because, if left in its existing condition, the channel bed downstream of the improvements would be free to degrade. This grade control structure would prevent any headcuts, or general channel bed degradation, from advancing upstream. In addition, three sites proposed for bank stabilization (see descriptions below) would be keyed in at the downstream end to grade control structures, to provide long-term degradation scour protection for the sites.

Non-woven geotextile fabric and a 6-inch layer of rock bedding would be placed within the footprint of each grade control structure to prevent it from settling and becoming ineffective. Large diameter stone (one-half to 8-ton class) would be embedded from 3 to 10 ft into the creek bed and banks, creating a 3- to 9-foot deep layer that will allow the creek to reach its "equilibrium slope," and also allow local scour pools to form downstream of the structures. Rock would be placed in compression from downstream to upstream at a 20H:1V (horizontal:vertical) slope, and each structure would have a crest no more than 4 ft higher than the existing creek bed. The creek bed would eventually become level with the crest as sediment is trapped behind it. Fish ladder pools will be incorporated into the downstream slope of the structures to allow fish passage and enhanced aquatic habitat. Pools formed upstream of the crest would provide habitat in low flow conditions.

Rock keys would be constructed at the upstream end of each grade control, from 3 to 9 ft into the existing bank, up to the 100-year flood level, to prevent possible flanking of the structures during peak runoff events. Rock keys would extend up to 20 ft on the creek banks with a 1.5H:1V maximum grade.

Grade control structures would range from 60 to 170 ft in length. For each structure, approximately 1,500 yd³ of soil would be

excavated within the creek bed and banks, and replaced with 4,000 tons of rock.

Pole plantings of live willow branches would be placed at the toe of the slope and upstream of the rock keys, and integrated during rock placement to add strength, trap sediment, and create riparian habitat. After placement of the rock riprap, sand and gravel would be placed over each grade control structure to fill in voids. Detailed illustrations of grade control structures are presented in Appendix A, Sheet 8.

2.1.1.10 Bank Stabilization Site 1

Site 1 is located immediately west of the Hwy 1-San Antonio Road West intersection, on the north side of the latter (Figure 2-1). San Antonio Creek has eroded to near vertical at the toe of the embankment at this site. The overall height of the slope is approximately 85 ft between the road surface and the streambed elevation (HDR 2008). San Antonio Road West is constructed on embankment fill within this site.

Improvements at Site 1 are designed to provide 100-year flood protection for the south bank of San Antonio Creek, near San Antonio Road West. Bank stabilization would be accomplished by installing a living dike system (to redirect the creek thalweg); bank protection; and a vegetated longitudinal peak stone toe (to prevent flanking of the bank protection on the south bank of San Antonio Creek). A point bar on the north bank would be graded, with a terrace at the 2-year flood elevation, and another at the 5-year flood elevation. The increased cross-sectional area, and cover and geotechnical strength provided by the biotechnical plantings, would reduce channel bank erosion, improve natural stream function, and enhance riparian habitat. Access to Site 1 would be restricted to routes (Section 2.1.1.1) originating from Hwy 1, San Antonio Road West, and Sheridan Road (Figure 2-1). The improvements proposed for Site 1 are illustrated in Appendix A, Sheet 5.

Living Dikes

A living dike system would be used to redirect creek flows away from the current reach and into a new low flow channel. This new 25-foot wide channel would be graded 30 to 160 ft north of the eroded south bank, redirecting approximately 600 ft of San Antonio Creek. The living dike system would consist of three trenches excavated approximately 2 to 3 ft deep, with willow poles planted in each, and backfilled with the excavated soil. One trench would extend 300 ft on the south bank, parallel to the redirected creek flow. Two additional trenches, 120 ft in length, would extend perpendicular to the redirected creek flow on the south bank, to the tie-back on the existing creek bank. An additional impoundment would be installed for willow storage during project implementation and would be removed upon completion of the project.

Bank Protection

The top of the existing embankment would be graded at a 2 percent minimum grade to drain toward San Antonio Road West. Approximately 6,660 yd³ of soil would be excavated from the top of the existing slope with a staggered cut to key into the slope. Compacted fill material (approximately 44,000 yd³) excavated from the project site would be used to rebuild approximately 500 linear feet of the south creek bank to a 2.25H:1V slope. The area would be cleared of existing vegetation and scarified prior to placement of fill.

Granular filter would be placed to secure the soil fill. The bank would be armored with a 3.4-foot layer of vegetated rock riprap up to the 100-year flood level (15 ft vertically) for stability. Approximately 3,200 tons of one-half ton rock would be placed along the creek bank at this site. Pole plantings would be integrated behind the riprap protection during rock placement. Poles would be laid on the bank extending below the seasonal saturation zone, with the tips bent to a vertical position through the riprap, creating a dense and continuous vegetative cover (commonly referred to as the bent pole method). Once

established, root systems of these trees would help to bind the creek bank in place, providing additional bank stabilization, and establishing vegetative growth within the rock. The rock would be soil filled and the area revegetated (see Section 2.1.1.5).

A stone toe would be constructed along the realigned south creek bank (500 ft) to protect against bend scour, and provide a stabilized foundation for installing willow cuttings. Approximately 1,650 yd³ of soil would be excavated from the existing creek bed and bank to place 3,000 tons of one-half ton rock on a 1.5H:1V slope. Granular filter would be placed below the riprap. The rock would have a parallelogram cross section, with a vertical height of 9 ft, extending 5 ft below the creek bed and 4 ft above, and a 12-foot horizontal base.

Live siltation would be placed in between the toe of the slope and the longitudinal stone toe protection. The downstream end of the bank protection would be contiguous to a grade control structure. These structures would provide long-term degradation scour protection for this site.

Longitudinal Peak Stone Toe Protection

Longitudinal peak stone toe protection would be installed approximately 280 ft upstream of the south creek bank protection. Rock would be placed on a granular filter following the old creek bed alignment, forming a triangular cross section of riprap with 1.5H:1V side slopes, a peak extending up to the 5-year flood level (4 ft in height), and a 12-foot horizontal base. Live siltation would be placed on the south face of the longitudinal peak stone toe. The pole bundles and area between the south creek bank and stone toe would be backfilled with approximately 830 yd³ of soil. This area would be revegetated as described in Section 2.1.1.5.

Approximately 12 yd³ of soil would be excavated from the embankment to tie-back the longitudinal peak stone toe into the creek bank. The pole bundles and area between the south creek bank and longitudinal peak stone toe would be backfilled with riprap, and

embedded into the creek bank a minimum of 3 ft. The riprap would also be keyed in to the creek bank a minimum of 5 ft at the upstream and downstream ends. An estimated 500 tons of one-half ton rock would be used for the longitudinal peak stone toe and its tie-backs.

Floodplain Terrace

Approximately 580 linear feet of the creek bed would be excavated to create a new low flow channel, 20 to 25 ft in width. The north creek bank would be excavated to create a floodplain terrace at the 2-year and 5-year water surface elevations. A 2H:1V slope would be excavated above the 5-year floodplain terrace to the top of the embankment. In addition, a slope would be graded between the low flow channel and the living dike system. Approximately 40,100 yd³ of soil would be excavated from the new creek bed and north bank. The area would be revegetated as described in Section 2.1.1.5.

Guardrails

The existing guardrail on the westbound shoulder of San Antonio Road West would be extended to provide public protection from the steep embankment near the roadway. Metal beam guardrails, with wood posts and blocks, would be installed 170 ft at the west end and 70 ft at the east end of the existing guardrail. A 1-foot square area would be excavated to a depth of 3 to 4 ft to install each wood post.

2.1.1.11 Bank Stabilization Site 2

Site 2 is located adjacent to the westbound shoulder of San Antonio Road West, approximately 2,000 ft west of Hwy 1 (Figure 2-1). Approximately 120 ft of the north bank at this site is armored with concrete rubble inclined at approximately 1.5H:1V. A concrete ditch located along the eastbound shoulder of San Antonio Road West, and a cross culvert, discharge onto the armored portion of the slope. The height of the creek bank is approximately 35 ft between the road surface and the streambed elevation (HDR 2008).

Improvements at Site 2 are designed to stabilize the existing slope, and improve the function of the north overbank. The protection consists of a vegetated longitudinal peak stone toe; vegetated mechanically stabilized earth (VMSE) fill slope; floodplain terrace; and construction of a rock swale for an existing corrugated metal pipe (CMP) outfall. Access to Site 2 would be restricted to designated routes (Section 2.1.1.1) originating from San Antonio Road West and Sheridan Road (Figure 2-1). The improvements proposed for Site 2 are illustrated in Appendix A, Sheet 6.

Longitudinal Peak Stone Toe Protection

Approximately 200 ft of San Antonio Creek would be redirected 25 ft north, away from the eroded south bank, to improve the channel planform and stream function. To protect against bend scour, a longitudinal peak stone toe would be constructed along approximately 410 linear feet of the south creek bank, below the existing concrete rubble and the adjacent upstream creek bank. Stone protection is required to prevent bank erosion where creek flows directly impinge on this bank. In addition, it would stop the migration of the creek towards San Antonio Road West, preventing its eventual collapse at this site. The longitudinal peak stone toe would also provide a stable foundation for establishing willow vegetation with live siltation.

Approximately 1,000 yd³ of soil would be excavated from the creek bed and banks to place rock riprap. A granular filter would be placed in the toe, and 2,460 tons of large diameter rock placed on top, along the bank, to form a 1.5H:1V slope. The rock would be embedded approximately 5 ft below the creek bed, and extend 12 ft toward the creek channel. Rock riprap would be placed up to the 2-year flood level (4 ft) on the south creek bank.

The stone toe would be keyed in upstream a minimum of 5 ft at two levels (the 5-year and 100-year flood levels) to prevent flanking of the riprap. The downstream end of the rock protection would be tied into a grade control

structure, providing general scour protection for the site.

Live siltation would be placed on the south face of the stone toe protection. In addition, pole plantings would be integrated during rock placement and bent up through the riprap to create a dense and continuous vegetative cover.

Vegetated Mechanically Stabilized Earth

Protruding rebar present in the existing concrete rubble on the south creek bank would be trimmed, and the rubble choked with approximately 2,700 yd³ of sand. Sand would be imported to the project site unless a large quantity of suitable material is available within the project area. Approximately 300 linear feet of the south creek bank would be rebuilt to a 2H:1V slope with an additional 5,700 yd³ of fill material excavated from the project site.

Live willow branches would be layered (brushlayering) in lifts with compacted soil as the slope is constructed, up to the 100-year flood level. Coir netting would be rolled out over each lift and slope face, to act as an erosion control blanket until vegetation can be established, and to confine the soil between the layers of live vegetative material, creating a vegetated retaining wall. The area above the soil lifts would be revegetated as described in Section 2.1.1.5.

Floodplain Terrace

The north creek bank would be excavated to create a new 20 to 25 ft wide, 160 ft long, low flow channel, and floodplain terrace at the 2-year flood level elevation, with a 2H:1V slope from above this terrace to the 100-year flood level. Approximately 8,600 yd³ of soil would be excavated on the north creek bank. The area would be revegetated as described in Section 2.1.1.5.

Rock Swale

A rock swale would be constructed to carry surface flows from an existing 30-inch diameter CMP installed beneath San Antonio Road West, down the south embankment, to the longitudinal peak stone toe protection. A 3.5-foot layer of large diameter rock

(approximately 230 tons) would be embedded into the VMSE, on top of a granular filter, to create a rock swale approximately 16 ft wide and 75 ft long. The rock would be soil filled and the area would be revegetated (as described in Section 2.1.1.5).

Guardrail

A 270 ft long metal beam guardrail with wood posts and blocks would be installed on the westbound shoulder of San Antonio Road West to provide public protection from the steep embankment near the roadway. A 1-foot square area would be excavated to a depth of 3 to 4 ft to install each wood post.

2.1.1.12 Bank Stabilization Site 3

Site 3 is located approximately 1,400 ft downstream from Site 2, where the Lee Road Utility Bridge crosses San Antonio Creek (Figure 2-1). Along the northern abutment of the utility bridge, the creek is armored with gabions (a cylindrical framework filled with rocks); the southern abutment is armored with rock slope protection. The creek banks are inclined at approximately 1.5H:1V, and are approximately 30 ft high between the road surface and the streambed elevation (HDR 2008).

Improvements at Site 3 are designed to prevent flanking of the existing rock riprap on the southern bridge abutment approach. Bank stabilization would consist of installing a vegetated longitudinal peak stone toe with live siltation, and grading a floodplain terrace. In addition, rock riprap that has fallen into the creek channel would be removed and placed as part of the toe. Access to Site 3 would be restricted to designated routes (Section 2.1.1.1) originating from Lee Road and Sheridan Road (Figure 2-1). The improvements proposed for Site 3 are illustrated in Appendix A, Sheet 7.

Longitudinal Peak Stone Toe Protection

Stabilization of the southern creek bank at Site 3 would include installing rock riprap along 150 ft at the toe of the slope, upstream of the existing riprap. Approximately 330 tons of one-half ton rock placed on the creek bed

would form a 1.5H:1V cross section of riprap, 5 ft in height, with a 12- to 15-foot horizontal base. Live siltation would be placed on the south face of the stone toe protection. The live siltation and the area between the south creek bank and stone toe would be backfilled with approximately 180 yd³ of soil. Granular filter would be placed below the rock and soil fill.

In addition, 74 yd³ of soil would be excavated and replaced with 151 tons of 4-ton rock to key the stone toe protection into the south creek bank and prevent flanking of the riprap. Geotextile fabric and rock bedding would be placed below the rock keys for stabilization. The stone toe would be keyed in upstream a minimum of 5 ft into the creek bank, and to the 5-year flood level. The downstream end of the toe protection would be keyed along 10 ft, approximately 7 ft into the creek bank, and tied into the existing rock riprap bank protection. The stone toe would provide a stabilized transition to the existing rock riprap on the south bank. A grade control structure located downstream of the Lee Road Utility Bridge would tie into the existing rock riprap and gabion protection, providing long-term degradation scour protection for this site.

Revegetation of Existing Bank Protection

The existing rock riprap on the south creek bank (approximately 0.1 acre) and wire gabions on the north creek bank (approximately 0.2 acre), adjacent to the utility bridge, would be filled with a graded aggregate or fill material excavated from the project site, receive a 1-foot soil and mulch layer, and revegetated (see Section 2.1.1.5). Where possible, pole plantings would be incorporated into the bank protection.

Floodplain Terrace

The north creek bank would be excavated to create a terrace at the 2-year flood level, and a 2H:1V slope above this terrace up to the 5-year flood level. Approximately 2,900 yd³ of soil would be excavated from the north creek bank.

2.1.2 Post-Construction Monitoring and Maintenance

Post-construction monitoring to assess the effectiveness of initial revegetation efforts, and provide guidance for follow-up maintenance, would occur for a period of 5 years. Monitoring would focus on the extent of native species cover and diversity.

Planted areas would be maintained, as required, to ensure the National Pollutant Discharge Elimination System (NPDES) Construction General Permit termination requirements are met. Non-native invasive plant species within the restoration area would be eradicated to ensure successful establishment of native species. It is anticipated that monitoring and eradication of invasive plant species would be necessary throughout the post-construction monitoring and maintenance period.

2.2 Alternative B: No-Action Alternative

Under the No-Action Alternative, none of the restoration and bank protection measures described under the Proposed Action would be implemented within San Antonio Creek.

Because the banks of San Antonio Creek would continue to be unprotected, they would be subject to further erosion by future storm flows. Over time, the south bank of San Antonio Creek would continue to migrate toward San Antonio Road West, eventually undermining the roadway and forcing the closure of the road.

The loose concrete rubble placed during the 1998 emergency repairs on the south bank, adjacent to San Antonio Road West, and around footings of the Lee Road Utility Bridge, would remain without any additional reinforcement. Because the toe of the slope has not been reinforced below the surface, it would be subject to erosion by future storm flows. Eventually, this could undermine the loose rock and rubble supported on the slope above. Areas adjacent to these slopes would

continue to be threatened by the eroding and undercutting of the watercourse. As a result, the emergency protection to the creek bank and bridge abutments could be undermined and fail during future major creek flows, undermining the roadway and threatening the bridge structure.

2.3 Other Alternatives Considered and Eliminated from Further Analysis

Natural and cultural resource concerns precluded the consideration of the alternatives discussed in this section. EO 11990, *Protection of Wetlands*, prevents the Air Force from approving projects if there are “practicable” or reasonable alternatives to impacting wetlands.

2.3.1 Alternative C

Under Alternative C, fill material would be used to restore the south bank of San Antonio Creek and rock riprap would be used to act as an embankment revetment to prevent future erosion. A Draft EA underwent public review in February 1999 (USACE 1999). Potential significant impacts to biological resources due to a permanent loss of riparian habitat eliminated further consideration of this alternative.

2.3.2 Alternatives D through G

In 2002, the 30th Civil Engineer Squadron (30 CES) contracted a study (Tetra Tech 2002) to recommend more environmentally friendly design alternatives to the previously proposed actions of the 1999 Draft EA. The study looked at erosion control, bank stabilization, and roadway alternatives in depth. Construction of a parallel channel was also considered. These alternatives are described in greater detail below.

2.3.2.1 Alternative D

Under Alternative D, the recommended approach at two sites was rock riprap for sloped areas, and gabions for vertical areas

within the zone below the 100-year flood level, referred to as the “flow zone.” Live fascines (bundles of woody vegetation buried in trenches below the creek parallel to creek flow) would be used in sloped areas, and gabions in vertical areas of the zone above the 100-year flood level, referred to as the “no flow zone.” At a third site, rock riprap or vegetated geogrids were recommended for the flow zone, and live fascines for the no-flow zone. This alternative would limit revegetation of the slope; therefore it was eliminated from further consideration due to the potential for significant impacts to biological resources.

2.3.2.2 Alternative E

Under Alternative E, the intersection of San Antonio Road West and Hwy 1 would be moved either east or west, realigning segments of the roadway further to the south at two sites. The roadway realignments would require stabilization of the creek banks but would allow flatter slopes and more opportunity for revegetation.

Excavation associated with these roadway realignments has the potential to adversely affect buried cultural resources recorded in this area. For this reason, Alternative E was eliminated from further consideration.

2.3.2.3 Alternative F

Alternative F proposed the construction of a new roadway to the north of San Antonio

Creek and the removal of the existing roadway entirely from the path of future creek meandering. Alternative F would not allow for continued access from Hwy 1 to San Antonio Road West and the facilities along the road. For this reason, Alternative F was eliminated from further consideration.

2.3.2.4 Alternative G

Alternative G proposed bank stabilization and construction of a parallel, secondary channel at two sites north of San Antonio Creek, to divert peak flow away from the south banks. Although the parallel channel would likely improve the hydraulics of the main creek channel, and provide additional riparian habitat within the diversion channel, potential adverse impacts to existing wetlands could be significant. For this reason, Alternative G was eliminated from further consideration.

2.3.2.5 Alternative H

In November 2004, 30 CES proposed an alternative to realign San Antonio Road West parallel to and southwest of the existing road, with a new intersection at Hwy 1. Bendway weirs (low rock structures constructed at an upstream angle) would redirect creek flow away from the banks and provide new wetland habitat. This alternative was eliminated from further consideration due to the presence of cultural resources within the area and high construction costs.

[This page intentionally left blank.]

Chapter 3. Affected Environment

This chapter describes the existing environmental conditions near and within the proposed San Antonio Creek restoration area on VAFB that have the potential to be affected by the Proposed Action. The area considered for most resources was confined to the immediate area of the proposed restoration activities. As appropriate, for some environmental resources, a wider regional area was used.

3.1 Air Quality

Air quality is described based upon the concentration of pollutants in the atmosphere. These concentrations are expressed in units of parts per million (ppm) or micrograms per cubic meter ($\mu\text{g}/\text{m}^3$). The type and amount of pollutants emitted into the atmosphere, together with the size and topography of the air basin and the prevailing meteorological conditions, determine air quality. Comparing the concentration to state and federal ambient air quality standards assists with determining the significance of any particular pollutant concentration. These standards represent the maximum allowable atmospheric concentrations that may occur while still providing protection for public health and safety with a reasonable margin of safety.

The Clean Air Act (CAA) required the U.S. Environmental Protection Agency (EPA) to establish ambient ceilings for certain criteria pollutants. Subsequently, the U.S. EPA promulgated regulations that set the National Ambient Air Quality Standards (NAAQS). NAAQS have been established for carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO_2), ozone (O_3), particulate matter 10 microns or less in diameter (PM_{10}), particulate matter 2.5 microns or less in diameter ($\text{PM}_{2.5}$), and sulfur dioxide (SO_2). Of these seven criteria pollutants, five are primary pollutants;

emitted directly from a source. $\text{PM}_{2.5}$ is both a primary and secondary pollutant, and O_3 is a secondary pollutant, i.e., not directly emitted, but formed from the reaction of nitrogen oxides (NO_x) and reactive organic compounds (ROCs). The NAAQS are presented in Table 3-1.

Under the California CAA, California established air quality standards for the state, known as the California Ambient Air Quality Standards (CAAQS). CAAQS are generally more stringent than the NAAQS, and there are additional CAAQS for sulfates (SO_4), hydrogen sulfide (H_2S), vinyl chloride, and visibility reducing particulate matter. The CAAQS are also presented in Table 3-1.

The area affected by the emissions from the Proposed Action includes VAFB and the surrounding portions of Santa Barbara County. For CO, NO_2 , PM_{10} , and SO_2 , the affected area is generally limited to a few miles downwind of the emission source, while for O_3 it can extend many miles downwind. Because the reaction between ROCs and NO_x s usually occurs several hours after they are emitted, the maximum O_3 level can be many miles from the source; therefore, the area affected by O_3 and its precursors produced by VAFB, could include most of northern Santa Barbara County. In addition, O_3 and its precursors transported from other regions can combine with local emissions to produce high, local O_3 concentrations.

3.1.1 Regional Climate and Meteorology

The climate at VAFB can be characterized as cool and wet from November through April and warm and dry from May through October. The average annual rainfall is approximately 14.7 inches, most of which falls between November and May (unpub. data, 30 SW). Winds are usually light during the nighttime

Table 3-1. Ambient air quality standards.

Pollutant	Averaging Time	CAAQS ^(1,3)	NAAQS ^(2,3)	
			Primary ⁽⁴⁾	Secondary ⁽⁵⁾
Ozone	8-hour	0.07 ppm (137 µg/m³)	0.08 ppm (157 µg/m³)	Same as Primary
	1-hour	0.09 ppm (180 µg/m³)	--	
Carbon Monoxide	8-hour	9.0 ppm (10 mg/m³)	9 ppm (10 mg/m³)	None
	1-hour	20.0 ppm (23 mg/m³)	35 ppm (40 mg/m³)	
Nitrogen Dioxide*	Annual Arithmetic Mean	0.03 ppm (56 µg/m³)	0.053 ppm (100 µg/m³)	Same as Primary
	1-hour	0.18 ppm (338 µg/m³)	--	
Sulfur Dioxide	Annual Arithmetic Mean	--	0.03 ppm (80 µg/m³)	--
	24-hour	0.04 ppm (105 µg/m³)	0.14 ppm (365 µg/m³)	--
	3-hour	--	--	0.5 ppm (1300 µg/m³)
	1-hour	0.25 ppm (655 µg/m³)	--	--
PM ₁₀	Annual Arithmetic Mean	20 µg/m³	--	Same as Primary
	24-hour	50 µg/m³	150 µg/m³	
PM _{2.5}	Annual Arithmetic Mean	12 µg/m³	15 µg/m³	Same as Primary
	24-hour	No State Standard	35 µg/m³	
Sulfates	24-hour	25 µg/m³	No Federal Standards	
Lead	30-day average	1.5 µg/m³	--	--
	Calendar Quarter	--	1.5 µg/m³	Same as Primary
Hydrogen Sulfide	1-hour	0.03 ppm (42 µg/m³)	No Federal Standards	
Vinyl Chloride	24-hour	0.01 ppm (26 µg/m³)	No Federal Standards	
Visibility Reducing Particles	8-hour	Extinction coefficient of 0.23 per kilometer – visibility of ten miles or more due to particles when relative humidity <70%.	No Federal Standards	

NOTES:

*The Nitrogen Dioxide ambient air quality standard was amended on February 22, 2007, to lower the 1-hr standard to 0.18 ppm and establish a new annual standard of 0.03 ppm. These changes become effective after regulatory changes are submitted and approved by the Office of Administrative Law.

(1) California Standards for ozone, carbon monoxide, sulfur dioxide (1- and 24-hour), nitrogen dioxide, PM₁₀, PM_{2.5}, and visibility reducing particles are not to be exceeded. Sulfate, lead, hydrogen sulfide, and vinyl chloride standards are not to be equaled or exceeded.

(2) National Standards, (other than ozone, particulate matter, and those based upon annual averages or average arithmetic means) are not to be exceeded more than once a year. The ozone standard is attained when the fourth highest eight-hour concentration in a year, averaged over three-years, is equal to or less than the standard. For PM₁₀, the 24-hours standard is attained when 99% of the daily concentrations, averaged over three years, are equal to or less than the standard. For PM_{2.5}, the 24-hours standard is attained when 98% of the daily concentrations, averaged over three years, are equal to or less than the standard.

(3) Concentration expressed first in units in which it was promulgated. Equivalent units given in parentheses are based upon a reference temperature and pressure of 25 degrees Celsius (°C) and 760 millimeters of mercury (mm Hg), respectively. Most measurements of air quality are to be corrected the reference temperature of 25 °C and reference pressure of 760 mm Hg; ppm in this table refers to ppm by volume or micromoles of pollutant per mole of gas.

(4) National Primary Standards: The level of air quality necessary, with an adequate margin of safety to protect the public health.

(5) National Secondary Standards: The level of air quality necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant.

hours, reaching moderate speeds of approximately 12 miles per hour (mph) by the afternoon. Winds are most often northwesterly on north Base and north to northeasterly on south Base. The strongest winds are associated with rainy season storms.

VAFB is subject to early morning and afternoon temperature inversions about 96 and 87 percent of the time, respectively. In an inversion, air temperature rises with increasing altitude, which confines the surface air and prevents it from rising. This restricts the vertical dispersion of pollutants and, therefore, increases local pollutant concentrations. Pollutants are "trapped" under an inversion layer until either solar radiation produces enough heat to lift the layer or strong surface winds disperse the pollutants. In general, these conditions occur most frequently during the nighttime and early morning hours.

3.1.2 Existing Air Quality

The U.S. EPA classifies air quality within each air quality control region with regard to its attainment of NAAQS. The California Air Resources Board (CARB) does the same for CAAQS. An area with air quality better than state or federal ambient air quality standards for a specific pollutant is designated as attainment for that pollutant. Any area not meeting those standards is classified as non-attainment. Santa Barbara County is in attainment or unclassified for all the ambient air quality standards except for the state standards for PM₁₀ and O₃.

The estimated emissions for Santa Barbara County and VAFB are presented in Tables 3-2 and 3-3. In Table 3-2, the Santa Barbara County emissions are 2002 daily planning emissions taken from the 2007 Santa Barbara County Air Pollution Control District (SBCAPCD) Clean Air Plan, while the VAFB emissions are annual emissions taken from the *2001 Comprehensive Emission Inventory Draft Report*.

Table 3-2. Existing emissions.

Source	2002 Emissions			
	Annual (Tons/Year)		Planning Day (Tons/Day)	
	NO _x	ROC	NO _x	ROC
<i>Santa Barbara County</i>	<i>16,155.94</i>	<i>43,439.57</i>	<i>41.2055</i>	<i>40.8432</i>
Stationary Sources	2,468.61	3,210.78	6.1160	9.3072
Area-Wide Sources	412.42	3,731.71	0.6326	9.9218
Mobile Sources	12,412.43	7,888.88	33.9613	21.6142
Natural Sources		28,608.20		882.4800
<i>Outer Continental Shelf Sources</i>	<i>14,324.89</i>	<i>3,499.34</i>	<i>39.2558</i>	<i>3.8761</i>
Stationary Sources	305.16	425.88	0.8361	1.1667
Mobile Sources	14,019.73	994.56	38.4197	2.7094
Natural Sources		2,078.90		
Total	30,480.83	46,938.91	80.4613	44.7193
VAFB Annual	1,134	229	ND	ND

ND = Not determined

SOURCE: 2007 Clean Air Plan, Santa Barbara County's plan to maintain the federal 8-hour ozone standard and attain the state 1-hour ozone standard, August 2007.

Table 3-3. VAFB annual emissions (tons) in 2006.

	CO	NO _x	PM ₁₀	SO _x	ROC
Mobile					
On-Road	402.75	160.71	2.08	NE	46.06
Off-Road	575.78	20.02	2.34	0.91	20.60
Aircraft/Launch Vehicles	97.45	14.69	6.87	1.60	37.19
Permitted Sources	NE	1.35	0.48	0.42	3.30
Exempt Source	NE	19.63	NE	NE	32.96
Total	1,075.98	216.40	11.77	2.93	140.11

NE = Not estimated

SOURCE: VAFB, 30 CES/CEV, unpublished data

On January 24, 2007, President Bush issued EO 13423, *Strengthening Federal Environmental, Energy, and Transportation Management*. One of the main goals established under this EO is the reduction of greenhouse gases through a reduction in energy intensity of 3 percent per year or 30 percent by the end of fiscal year 2015.

3.2 Biological Resources

Federal agencies are required by Section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 *et seq.*), to assess the effect of any project on federally listed threatened and endangered species. Under Section 7, consultation with the U.S. Fish and Wildlife Service (USFWS) and the National Oceanic and Atmospheric Administration National Marine Fisheries Service (NOAA Fisheries Service) is required for federal projects if such actions could directly or indirectly affect listed species (threatened, endangered, rare, or candidate) or destroy or adversely modify critical habitat. It is also Air Force policy to consider listed and special status species recognized by state agencies when evaluating impacts of a project.

Biological resources on VAFB are abundant and diverse because the Base is within an ecological transition zone, where the northern and southern ranges of many species

overlap, and because the majority of the land within its boundaries has remained undeveloped. Fourteen major vegetation types have been described and mapped on VAFB (VAFB *In Progress*), which provide habitat for many federal and state listed threatened, endangered, and special concern plant and animal species.

3.2.1 Methodology

A literature search, general biological survey, and special status species survey were used to characterize the biological resources within the proposed project area. The scope of the biological surveys included vegetation and wildlife resources, as well as waters of the U.S. and wetlands. Field surveys and habitat assessments were completed from February through April 2008. Dominant and special status plant species, and vegetation types were identified and documented. Sight, sound, tracks, or other signs, determined presence of common and special status wildlife species.

Potential occurrence of plant and wildlife species, including special status species, was determined based on suitability of habitat and known occurrence, based on literature searches and other existing documentation. Sources used to determine potential occurrence include literature and maps of natural resources present at VAFB, California Natural Diversity Database (California Department of Fish and Game [CDFG] 1999,

2001, 2008a, 2008b); and existing local and regional references (Christopher 1996, 2002; Coulombe and Mahrtdt 1976; Holmgren and Collins 1999; Keil and Holland 1998; Lehman 1994). Existing special status species surveys and location maps (SRS Technologies, Inc. [SRS] 2006, 2007; MSRS et al. 2008) were superimposed over the project area, via Geographic Information System (GIS) layers, and intersecting occupied habitat was documented and/or reviewed.

Delineation of wetlands within the proposed project area was conducted from February to April 2008 (MSRS 2008). Wetlands were delineated in accordance with the USACE *Wetland Delineation Manual* (1987), which requires an area to meet specific criteria for each of three wetland parameters (vegetation, hydrology, and soils) to be considered a wetland. Transects, oriented in a north-south direction perpendicular to the creek channel, were established at approximately 300- to 400-foot intervals for the entire length of the project area. Exact placement of these transects was based on site conditions. Four supplemental transects were established in intervening areas where additional plots were needed to determine wetland boundaries. Representative plots were chosen along each transect within different vegetation types, growing conditions, and/or at wetland-upland interface areas. Vegetation, hydrology, and soils were characterized for each plot, and the results recorded on USACE Wetlands Delineation Forms. The locations of soil test pits were documented using Global Positioning System (GPS) units. Appendix D contains the *Assessment of the Wetland Habitats at the San Antonio Creek Restoration Site* (MSRS 2008).

Waters of the U.S. encompass the jurisdictional limits of the authority of the USACE and include streams and their tributaries that have defined bed and banks and/or that have an OHWM, which is a line on the shore established by the fluctuations of ordinary water flows, as well as adjacent jurisdictional wetlands (33 CFR 320-330). The limits of jurisdictional waters of the U.S.

were determined based on the characteristics of the banks of San Antonio Creek.

3.2.2 Vegetation Types

Approximately 41.28 acres of large areas devoted to agricultural fields and incised creek banks devoid of vegetation are present within the project area. Ten distinct natural vegetation types were identified within the project area (Figure 3-1), occurring as a mosaic of small patches or narrow bands. Vegetation types are described in detail below. Where suitable, nomenclature follows Holland (1986). Plant species nomenclature follows Hickman (1993). A complete list of species observed during field surveys is provided in Appendix C. Table 3-4 provides acreages of each vegetation type within the proposed project area.

Non-native Grassland

Non-native grassland is common in areas subjected to prior disturbance, allowing weedy non-native species to invade and become dominant. Within the proposed project area poison hemlock (*Conium maculatum*), black mustard (*Brassica nigra*), heart-podded hoary cress (*Lepidium draba*), and non-native annual grasses dominate this vegetation type.

Table 3-4. Vegetation types found within the proposed restoration area on VAFB.

Vegetation Type	Acreage
Non-native Grassland	29.51
Central Coast Scrub	9.08
Mixed Central Coast Scrub/ Non-native Grassland	2.28
Native Grassland	0.06
Willow Riparian	12.01
Mixed Willow Riparian/ Central Coast Scrub	0.81
Freshwater Marsh	3.18
Non-native Woodland	0.09
Ruderal	2.86
Agricultural	40.92

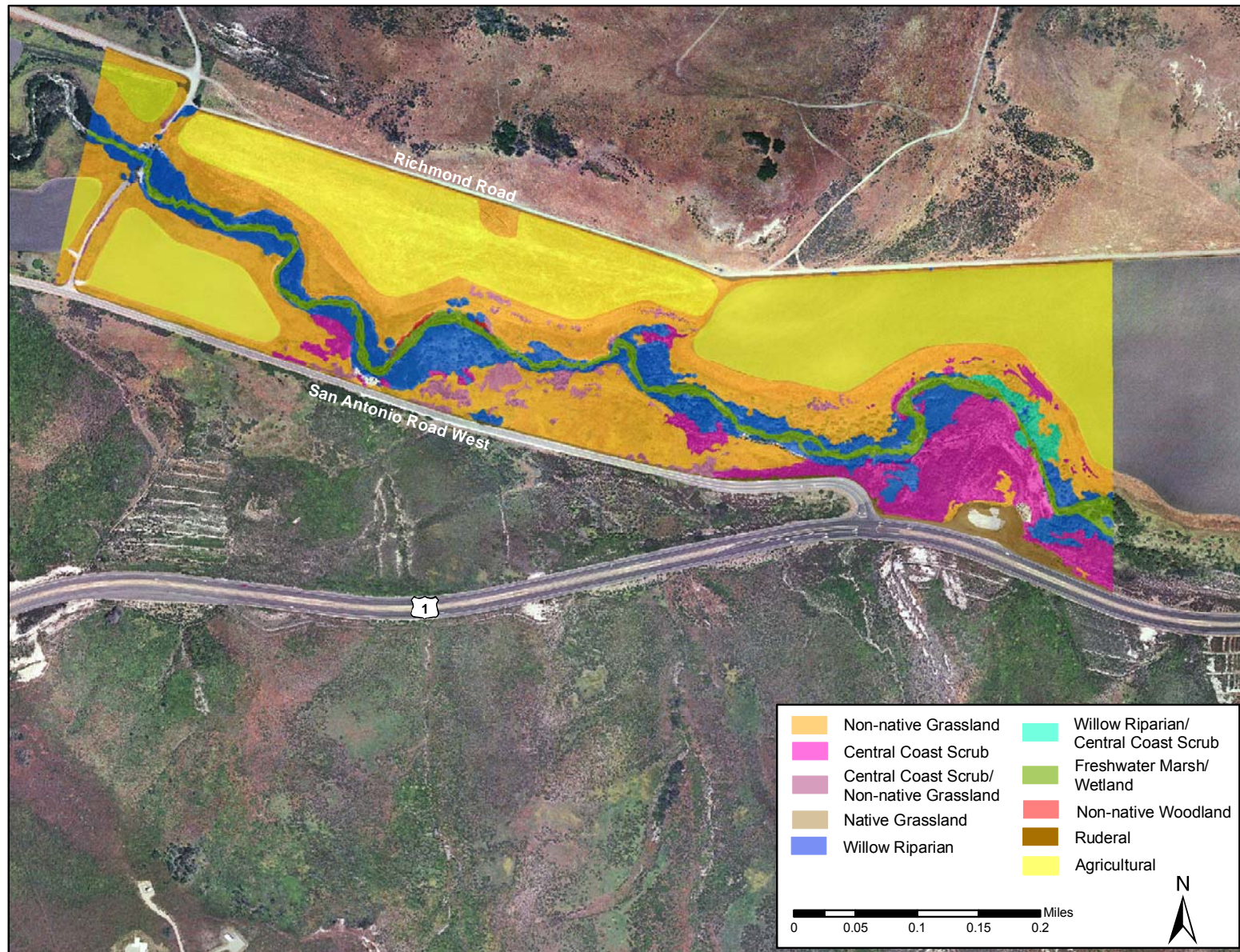


Figure 3-1. Vegetation types within the proposed project area.

Central Coast Scrub

Central coast scrub is a diverse community that occupies a narrow corridor extending along almost the entire coast of California. Shallow-rooted, mesophyllic plant species that are often drought-deciduous and summer-dormant characterize this community. Within the proposed project area, coyote brush dominates this vegetation type. California sagebrush (*Artemisia californica*), blue elderberry (*Sambucus mexicana*), and poison oak (*Toxicodendron diversilobum*) are also common components. Seaciff buckwheat (*Eriogonum parvifolium*), host plant of the federally endangered El Segundo blue butterfly (*Euphilotes battoides allyni*), is also present within this vegetation type. In most of the project area, annual non-native grassland species have invaded and now dominate the understory and openings in the shrub community.

Mixed Central Coast Scrub/ Non-native Grassland

Mixed Central Coast Scrub/Non-native Grassland is present where central coast scrub species have re-colonized areas of non-native grassland. Non-native grassland species such as heart-podded hoary cress dominate the intervening spaces and understory of the loosely clustered shrubs. Coyote brush is the dominant scrub species in these areas.

Native Grassland

Native grassland is extremely limited within the proposed project area, occurring in small patches totaling less than 0.1 acre. Native grasses and herbs such as giant wild rye (*Leymus condensatus*), and stinging nettle (*Urtica dioica*) dominate this vegetation type.

Willow Riparian

Willow riparian woodland is a dense, low, closed-canopy, broad-leafed, winter-deciduous, riparian forest dominated by red and arroyo willow (*Salix laevigata* and *S. lasiolepis*), which can grow as a tree or treelike shrub. A mature willow riparian community occupies the banks and slopes of

San Antonio Creek within the project area. Native overstory species include mugwort (*Artemisia douglasiana*), marsh baccharis (*Baccharis douglasii*), poison oak, and California blackberry (*Rubus ursinus*). Understory species are sparse in many of the riparian areas. In areas where exotic species have invaded the understory, heart-podded hoary cress, poison hemlock, and black mustard dominate.

Mixed Willow Riparian/Central Coast Scrub

Loosely spaced willows with interspersed coyote brush characterize mixed willow riparian/central coast scrub. Other species such as blue elderberry, poison oak, and California blackberry are also common components.

Freshwater Marsh

Freshwater marsh occurs primarily as an understory within willow riparian communities subject to scouring during high creek flows. This vegetation type is present within and immediately adjacent to the creek channel, on low-lying terraces, and along ephemeral and secondary channels. Dominant plant species include cattails (*Typha* spp.) and rushes (*Scirpus* spp.). In the San Antonio Creek watershed west of Barka Slough to the Pacific Ocean, freshwater marsh habitat increased in percentage from 1928 to 1990 (The Nature Conservancy 1995). Scouring storm flows throughout January 2008, washed away most wetland vegetation within the proposed restoration area. At the time of field surveys in early February, this vegetation type was observed in an early successional state, dominated by seedlings or resprouts from buried root material.

Non-native Woodland

Non-native woodland, dominated by tree tobacco (*Nicotiana glauca*), grows on and at the base of steep, eroding slopes bordering the creek channel within the proposed project area.

Ruderal

Ruderal vegetation typically occurs at roadsides, waste areas, and other sites

continuously disturbed by activities such as traffic, road construction, and road maintenance. Annual and usually non-native forbs and grasses that can rapidly invade disturbed areas dominate ruderal vegetation types. Ruderal vegetation types border the existing roads within the project area. Both weedy non-native species adapted to frequent disturbance, such as sow thistle (*Sonchus oleraceus*), plantain (*Plantago erecta*), and annual grasses, as well as native species from adjacent habitats, such as coyote brush, California sagebrush, and vervain (*Verbena lasiostachys*), are present within this vegetation type. Gaviota tarplant (*Deinandra increscens* ssp. *vollosa*), a federal and state endangered species, is common within the ruderal vegetation on VAFB.

Agricultural

Agricultural fields are sparsely vegetated due to regular intense disturbances such as mechanical disking. Due to an intense maintenance regime, perennial species are absent from these areas. Active agricultural areas are adjacent to San Antonio Creek within the proposed project area. Non-native annual grasses and forbs constitute the majority of vegetation present in these areas.

3.2.3 Wildlife Species

The diversity of fauna within and in the vicinity of the proposed project area may be attributed to the variety of habitat types along and adjacent to San Antonio Creek. Willow riparian woodland supports a wide variety of birds, due to the cover, foraging habitat, breeding and nesting habitat, and perch sites provided by the willow woodland (USACE 1998). In addition, a number of fish, reptile, amphibian, and mammal species use the upland and riparian habitats associated with San Antonio Creek for residence and migration corridors.

Wildlife species documented within the proposed project area are listed in Appendix C. This list also includes wildlife species not encountered during the surveys, but potentially present based on prior records

in the vicinity. Surveys of invertebrate species were not done.

More birds are found in riparian woodlands than in any other habitat type on VAFB. Forty-six species of birds have been observed in this habitat (VAFB *In Progress*). The most abundant species was house finch (*Carpodacus mexicanus*). Year-round inhabitants include Bewick's wren (*Thryomanes bewickii*), spotted towhee (*Pipilo maculatus*), and downy woodpecker (*Picoides pubescens*). The willows in the project area also provide valuable habitat for birds migrating through the area.

California red-legged frog, Pacific treefrog (*Pseudacris regilla*) and ensatina (*Ensatina eschscholtzii*), are common amphibian species found in riparian areas at VAFB. The California red-legged frog is federally listed as threatened.

Fish species known to occur within San Antonio Creek include tidewater goby (*Eucyclogobius newberryi*), mosquito fish (*Gambusia affinis*), arroyo chub (*Gila orcutti*), unarmored threespine stickleback, and prickly sculpin (*Cottus asper*) (Swift et al. 1997). The tidewater goby and unarmored threespine stickleback are federally endangered species.

Reptile species observed in riparian areas on VAFB include western fence lizard (*Sceloporus occidentalis*), southern alligator lizard (*Elgaria multicarinata*), side-blotched lizard (*Uta stansburiana*), and western skink (*Eumeces skiltonianus*).

Large- and medium- sized mammal species commonly found in willow riparian forests include Virginia opossum (*Didelphis virginiana*), desert cottontail (*Sylvilagus audubonii*), brush rabbit (*Sylvilagus bachmani*), long-tailed weasel (*Mustela frenata*), coyote (*Canis latrans*), raccoon (*Procyon lotor*), striped skunk (*Mephitis mephitis*), and bobcat (*Felis rufus*). Small mammals include various species of mice (*Peromyscus* spp.), dusky-footed woodrat (*Neotoma fuscipes*), and Trowbridge's shrew (*Sorex trowbridgii*).

3.2.4 Special Status Species

Table 3-5 lists federal and state threatened and endangered species and other special status species that occur or have the potential to occur within the project area and its vicinity. The following are brief species accounts of these species.

Several species were excluded from potential occurrence because they either do not occur at the site during the time project activities would occur, they do not breed within the project area and their special status affords them protection only during their breeding period, or they do not occur in the form that affords them special status protection (i.e., rookeries or nesting colonies). These species

and their current status are listed in Appendix C.

Unarmored Threespine Stickleback

The federally endangered unarmored threespine stickleback is a small, scaleless, freshwater fish that inhabits slow and quiet waters of streams and rivers. Historically, this species was found throughout southern California. By 1985, it only remained in a small portion of the upper Santa Clara River drainage and tributaries, in the lower 8.4 mi of the San Antonio Creek drainage and in Cañada Honda Creek (USFWS 1985).

Sticklebacks require slow water flow with low turbidity and aquatic vegetation for cover and

Table 3-5. Special status plant and wildlife species within the proposed project area.

Scientific Name Common Name	Status		Occurrence	Habitat	Comments
	USFWS ¹	CDFG ²			
Plants					
Deinandra increscens ssp. villosa Gaviota tarplant	FE	SE	Potential	Grassland, ruderal	Blooms June – September
Fish					
Gasterosteus aculeatus williamsoni Unarmored threespine stickleback	FE		Documented	Perennial streams	Breeds year-round - peak in March
Amphibians					
Rana aurora draytonii California red-legged frog	FT	CSC	Documented	Perennial ponds, streams	Breeds February – April
Invertebrates					
Euphilotes battoides allyni El Segundo blue butterfly	FE		Potential	Coastal sand dunes	Adult flight period June – September
Birds					
Agelaius tricolor Tricolored blackbird	BCC	CSC	Documented	Dense tule stands, fields, pastures	Breeds March – July
Lanius ludovicianus Loggerhead shrike	BCC	CSC	Documented	Forage over all open habitats, breeds in shrubs or trees	Breeds March - August
Reptiles					
Actinemys marmorata Western pond turtle		CSC	Documented	Perennial lakes, ponds, streams. Eggs laid in upland areas,	Hatchlings overwinter in nest; move to aquatic sites March-April.

NOTES:

1 FE = Federal Endangered Species FT = Federal Threatened Species BCC = Federal Bird of Conservation Concern

2 SE = California Endangered Species CSC = California Species of Concern

nest material. While adults can occupy all areas of a stream, they tend to gather in areas of slow moving or standing water. Population size estimates (Baskin and Bell 1976) indicate that the best habitat for sticklebacks is small clean ponds in a stream with a constant flow of water. Sticklebacks are sensitive to excessive sedimentation and the loss of habitat through changes in water flow, water level, and the growth of emergent plants.

Breeding activity of sticklebacks peaks in March; however, it continues at a lower level throughout summer and fall. Unarmored threespine sticklebacks make their nests where ample vegetation and a gentle flow of water are present. The number of suitable nesting sites may be a limiting factor for this species. Young sticklebacks tend to be found at the shallow edges of streams in areas of dense vegetation.

On VAFB unarmored threespine sticklebacks are native to San Antonio Creek and were introduced into Cañada Honda Creek in 1984 (USFWS 1985). No individuals have been documented in Cañada Honda Creek in the last 10 years, and population estimates for the San Antonio Creek population are currently unavailable.

Sticklebacks are the most common fish species observed in San Antonio Creek (Swift et al. 1997) and are expected to be present anywhere within the project area. Swift (1999) reported unarmored threespine stickleback in high densities in the low-gradient portions of San Antonio Creek, where creek flows are slow and the channel is wide, with the highest abundance occurring within 1.25 mi of El Rancho Road.

California Red-legged Frog

This highly aquatic federally threatened amphibian inhabits quiet pools of streams, marshes, and occasionally ponds, where it prefers shorelines with extensive vegetation. It is active year-round in coastal areas, and can be found in upland areas during the winter and early spring. California red-legged frogs may breed as early as November,

usually laying egg masses during or shortly following large rainfall events from late December to early April. Surveys conducted from 1995-2002 indicate California red-legged frogs begin breeding on VAFB in early January (Christopher 2002).

Critical habitat for the California red-legged frog was designated on March 13, 2001. VAFB was excluded from critical habitat designation under section 4(b)(2) of the federal ESA. As a result, the proposed project is not in critical habitat.

California red-legged frogs occur in nearly all permanent streams and ponds on VAFB (Christopher 1996). This species has been observed at every location surveyed along San Antonio Creek except near Hwy 1, where the water is too shallow (Christopher 1996). During the wetlands habitat assessment completed in February through April 2008, California red-legged frogs were regularly observed throughout the proposed creek restoration area. In August and September, the majority of California red-legged frog tadpoles would be expected to have metamorphosed. However, California-red-legged frog adults and tadpoles may occur anywhere along the creek during construction activities. Both juveniles and adults would be expected to use the project area as a travel corridor and may occur in any vegetation type within the project area where cover is present. Riparian vegetation immediately adjacent to the creek could be used as refuge for overwintering tadpoles.

El Segundo Blue Butterfly

The federally endangered El Segundo blue butterfly occurs in coastal dune scrub, along coastal bluffs and in central coastal scrub. The adult flight period (June-September) coincides with the blooming period of its host plant, seacliff buckwheat (Arnold 1978, 1983; Pratt and Ballmer 1993). Eggs are deposited on buckwheat flowers and buds where the larvae feed until maturation. Upon maturation larvae burrow into the soil and pupate, usually within the root and debris zone of the host plant (Mattoni 1992; Pratt and Ballmer, pers. obs.). Pupae remain in diapause until at least

the following flight season. The number of adult butterflies that emerge in a given year is dependent on environmental conditions. The majority of the pupae may remain in diapause if environmental conditions are not favorable (Pratt and Ballmer 1993).

The occurrence of El Segundo blue butterfly at VAFB represents a significant extension of the butterfly's geographic range. It was originally thought to be restricted to remnant habitat patches from Playa del Rey to the Palos Verdes Peninsula in Los Angeles County, California (Arnold 1978, 1981).

Surveys within the proposed project area occurred outside the flight period for this butterfly; the project area has not been surveyed during the adult flight period. Approximately 350 seaciff buckwheat plants occur adjacent to a previously disturbed construction staging area within the proposed restoration area. The presence of seaciff buckwheat within and adjacent to the project area is indicative of the potential for El Segundo blue butterfly to also occur within this area. The project area is approximately 5.4 mi from the nearest documented occurrence of El Segundo blue butterfly (MSRS et al. 2008).

Gaviota Tarplant

A member of the Aster family, the federally endangered Gaviota tarplant is a gray-green, hairy, summer flowering annual with stems branching near the base. This plant is most often associated with grasses, and on occasion, with coastal shrubs such as *Baccharis* and *Isocoma*. Gaviota tarplant is endemic to Santa Barbara County and there are several locations of this species on VAFB. While most locations are coastal, some extend inland.

The USFWS designated critical habitat for Gaviota tarplant on November 7, 2002. VAFB was excluded from this designation under section 4(b)(2) of the federal ESA. As a result, the proposed project is not in critical habitat.

In excess of 100 tarplant (*Deinandra increscens*) seedlings were documented

within the proposed project area. The February 2008 surveys were outside the plant's flowering period (May-September) when the federally endangered subspecies *villosa* is definitively identifiable. However, in areas surveyed adjacent to the proposed project area in the past, tarplant was found to be consistent with the common subspecies *increscens* (SRS 2007).

Tricolored Blackbird

Within California, this federal bird of conservation concern occurs in the Central Valley as well as along the central and southern coasts. Colonies require nearby water, a suitable nesting substrate, and open-range foraging habitat of natural grassland, woodland, or agricultural cropland. In the non-breeding months, tricolored blackbirds often roost at night in large flocks in wetlands, but during the day they commute to feeding areas. During the breeding season (March-July), tricolored blackbirds nest in tules, cattails, and willows, in or adjacent to freshwater or brackish wetlands. This species has been observed near San Antonio Creek, although there are no records of breeding (Holmgren and Collins 1999).

Loggerhead Shrike

This federal bird of conservation concern is a common resident and winter visitor in lowlands and foothills throughout California, preferring open habitats with scattered shrubs, trees, posts, fences, utility lines, or other perches. During the breeding period (March-August), it builds nests on stable branches of densely foliated shrubs or trees. Shrikes are regularly observed foraging throughout open areas adjacent to San Antonio Creek (Holmgren and Collins 1999, The Nature Conservancy 1995). The coastal scrub within and adjacent to the project site offers potential breeding habitat for this species.

Western Pond Turtle

This California species of concern inhabits rivers, streams, ponds, and other seasonal and perennial wetlands that have refugia and pools up to 1 meter (m) deep (Holland 1986).

Western pond turtles occur from the foothills of the Sierra Nevada to coastal and southern California. The breeding period for this species is April through August.

Western pond turtles were recorded within the proposed restoration area and downstream along San Antonio Creek and adjacent pools during surveys conducted in 1996 (Christopher), and during biological surveys conducted for the proposed creek restoration project in 2008. The riparian habitat within San Antonio Creek provides suitable breeding habitat for this species.

3.2.5 Other Species Considered

Other special status species considered include the federally endangered tidewater goby, southern steelhead (*Oncorhynchus mykiss*), Gambel's watercress (*Nasturtium gambellii*), and southwestern willow flycatcher (*Empidonax traillii extimus*). These species have not been documented within the project area; therefore, they were excluded from further discussion.

3.2.6 Waters of the United States and Wetlands

San Antonio Creek is actively adjusting its profile and channel geometry between Barka Slough and Lompoc-Casmalia Road, and has experienced significant erosion (degradation), deposition (aggradation), channel widening, and bend migration in recent years. The creek bed was substantially higher in elevation historically. Based on a comparison of topographic map data from 1993 and 2005, approximately 6 to 9 ft of degradation (channel lowering) has occurred within the proposed restoration area during this 12-year period (HDR 2008). The present alignment and location of the creek is the result of downcutting, scour and soil deposition that have restricted the flow. Because rainfall during the 2007-2008 season was average, the extent of the 2008 high flow was used to determine the OHWM.

For the wetland hydrology criterion to be met a site must be inundated or saturated or

exhibit features that show the area was inundated or saturated for the required period of time (i.e., 45 days). A wetlands habitat assessment was completed within the project area from February through April 2008 (MSRS 2008). A report summarizing the results of this assessment is included in Appendix D. During this assessment, drift lines and drainage patterns in wetlands were the most common and extensive primary indicators of wetland hydrology within the project area. Along the main channel of San Antonio Creek, where steep banks are present, pronounced terracing is also apparent, indicative of creek flow. In areas where rock riprap or vertical banks devoid of vegetation are present, water staining is the primary indicator of wetland hydrology. Saturation in the upper 12 inches was restricted to areas immediately adjacent to the main channel of San Antonio Creek, ephemeral feeder channels, and hillside seeps.

Areas that currently meet the criteria for wetlands include areas encompassed within the OHWM of San Antonio Creek, wetlands adjacent to the channel, and areas bound by the channel. A total of 3.18 acres of wetlands were identified within the creek restoration area. Waters of the U.S. encompass wetlands as well as areas of open water and areas bound by the OHWM. A total of 4.75 acres within the project area constitute Waters of the U.S. and are subject to the jurisdiction of the USACE under Section 404 of the Clean Water Act (CWA).

3.3 Cultural Resources

Section 106 of the of the National Historic Preservation Act (NHPA) requires federal agencies to assess potential project related effects to historic properties that are listed or eligible for listing in the National Register of Historic Places (NRHP). Associated implementing regulations include 36 CFR 800. A synopsis of the prehistory and ethnohistory of the region is included in Appendix E.

3.3.1 Cultural Resource Studies

An archaeological record search was completed at the California Historical Resources Information System Central Coast Information Center, University of California, Santa Barbara (UCSB), and the 30th Civil Engineer Squadron, Environmental Flight (30 CES/CEV) Cultural Resources Section at VAFB. Background research included a review of archaeological literature, archaeological base maps, and cultural resources records. Information was collected from previous inventories and archaeological studies within 1 mi, and known sites within 0.25 mi, of the project area. Maps consulted at the 30 CES/CEV Cultural Resources Section include the VAFB C-1 series (46 map set), Base Comprehensive Plan GIS, and U.S. Geological Survey (USGS) topographic maps. Aerial photographs at the UCSB Map and Imagery Library were also consulted.

Record search results indicate that 42 surveys or other cultural research studies have been conducted within 1 mi of the proposed project area (Table 3-6). Eleven of those studies are within or adjacent to the project area.

The earliest documented archaeological study in the project area was a large-scale inventory covering much of VAFB during the late 1960s and early 1970s (Spanne 1974). That survey encompassed several sections of San Antonio Creek, but was significantly hampered by dense vegetation along the creek. Four archaeological sites within 0.25 mi of the proposed project area (CA-SBA-1009, -1011, -1012, and -1013) were identified during this survey. Two of these sites (CA-SBA-1009 and -1011) are within or near the proposed project area.

Greenwood and Foster (1981) report archaeological investigations in the San Antonio Creek valley in conjunction with the Range Improvement Project. These investigations included a survey of 4.75 mi of fence line, as well as testing to evaluate significance and to assess potential adverse project effects at various sites along the creek channel. No new sites were identified within

the proposed project area, although their effort included minimal subsurface probing at two previously recorded sites (CA-SBA-1009 and -1011) within or near the project area.

Berry (1991) completed a survey for an overhead power line that crosses San Antonio Creek in the vicinity of the lower project area. Although numerous previously recorded sites were recognized within or near the power line corridor, no new sites were discovered adjacent to the creek.

In the mid-1990s, a basewide archaeological survey was completed that included the proposed project area (Carbone and Mason 1998). That effort identified no new archaeological resources within the current project area.

The Mission Hills and Santa Ynez Extensions of the Coastal Branch Aqueduct crossed the San Antonio Creek valley just west of the lower end of the proposed project area. A preconstruction survey of the aqueduct corridor did not identify archaeological resources in the valley bottom (Science Applications International Corporation [SAIC] 1994). However, in September 1994 construction of the aqueduct revealed a buried site (CA-SBA-2696) in the valley bottom. Subsequent testing revealed that CA-SBA-2696 is a stratified, multi-component site, encompassing approximately 78,000 square meters buried beneath alluvium (Price et al. 2006). The site was determined eligible for the NRHP in 1995 and data recovery excavations to mitigate the adverse effects of aqueduct construction were completed in 1996 (Colten et al. 1997).

Given the discovery of a significant buried site (CA-SBA-2696) in the San Antonio Creek valley (Colten et al. 1997; Price et al. 2006) during construction of the Coastal Branch Aqueduct, VAFB requested a survey of the cutbanks along San Antonio Creek as part of an archaeological study for the El Rancho Road Bridge Project (Lebow 2000). The survey encompassed both sides of the creek between the upper end of Barka Slough and Lompoc-Casmalia Road, including the proposed project area. Erosional cutbanks

Table 3-6. Previous cultural resource studies within one mile of the proposed project area.

References (in chronological order)	VAFB Reference Number	UCSB Reference Number
Spanne (1973)	VAFB-1973-01	
Spanne (1974)*	VAFB-1974-02	
WESTEC Services Inc. (1981)	VAFB-1981-04	V-16
Greenwood and Foster (1981)*	VAFB-1981-09	V-7
WESTEC Services Inc. (1982)	VAFB-1982-02	V-42
WESTEC Services Inc. (1983)	VAFB-1983-02	V-19
Rudolph (1983)	—	V-31
Greenwood (1984)	VAFB-1984-18	
Foster and Greenwood (1985)	VAFB-1985-12	
Stone (1985)	VAFB-1985-16	
Foster (1985)	VAFB-1985-19	V-23
Woodman et al. (1985)	VAFB-1985-23	
Thorne and Waldron (1985)	VAFB-1985-29	
Bowser and Morgan (1986)	VAFB-1986-03	
Stone (1986a)	VAFB-1986-04	
Stone (1986b)	VAFB-1986-18	
Gibson (1987a)	VAFB-1987-03	V-134
Gibson (1987b)	VAFB-1987-08	
Rudolph (1988)	VAFB-1988-08	V-201
Woodman and McDowell (1989)	VAFB-1989-08	V-208
Kirkish (1990)	VAFB-1990-12	
Berry (1991)*	VAFB-1991-03	V-131
Thorne (1993)	VAFB-1993-02	
Berry (1994)	VAFB-1994-01	
Science Applications International Corporation (1994)*	VAFB-1994-16	
Wilcoxon and Haley (1996)	—	V-165
Haslouer and Kay (1996)	VAFB-1996-09	
Woodman (1997)	—	V-163
Clark (1997)	VAFB-1997-01	V-159
Harro and Ryan (1997)	VAFB-1997-09	V-175
Colten et al. (1997)*	VAFB-1997-21	V-198a
Carbone and Mason (1998)*	VAFB-1998-03	V-258
Lebow (2000)*	VAFB-2000-17	V-285
Lebow and McKim (2001)	VAFB-2001-05	V-307
Harro and Lebow (2002)	—	V-308
Parreira (2003)*	M-2003-02	V-310
Mirro and Lebow (2003)*	VAFB-2003-02	
Davis (2003)	VAFB-2003-06	
Parreira (2004)	—	V-336
RESCOM Environmental Group Corp (2004)	—	V-371
Lebow et al. (2005)	—	V-367
Price et al. (2006)*	—	

*Within the proposed restoration area.

were examined to identify buried archaeological sites and isolated artifacts. That effort identified five previously unknown sites, all buried under non-cultural sediments. One of these sites, CA-SBA-3607, is within or adjacent to the proposed project area.

Applied EarthWorks, Inc. completed an archaeological survey after the Harris wildfire to take advantage of the increased surface visibility following the burn (Mirro and Lebow 2003). Only the northern bank of San Antonio Creek had burned in the vicinity of the proposed project area, so the only portion of the current project area surveyed was the northern bank at the eastern end of the project area. No new archaeological resources were identified.

In 2003, a new drainage system was installed along the eastern end of San Antonio Road West. Part of this effort included a concrete-lined ditch paralleling the southern edge of the road. This ditch terminated at a culvert that was buried under the road and emptied into San Antonio Creek at Bank Stabilization Site 2. An Applied EarthWorks, Inc. archaeologist and Native American representative (Parreira 2003) monitored excavations for the ditch and culvert. No archaeological resources were identified.

In 2004, a second survey of the San Antonio Creek cutbanks was completed to determine whether additional archaeological resources were exposed due to ongoing erosion. Again, this survey encompassed the proposed project area. No new archaeological resources were identified; however, previously recorded sites were examined more closely, cutbank exposures were profiled and, where possible, radiocarbon samples were collected. Analysis of 17 samples from buried sites revealed human occupations ranging between Anno Domini (A.D.) 120 and 5600 Before Christ (B.C.).

In support of the proposed creek restoration, VAFB conducted an Extended Phase -1 Archaeological Survey to identify buried archaeological deposits within the proposed project area in 2008. A series of 50-centimeter-diameter (1.6 ft) shovel test pits

were excavated to identify archaeological remains between the ground surface and 1 m (3.3 ft) below ground surface. To identify archaeological remains below 1 m (3.3 ft), non-traditional archaeological excavation methods were employed. A truck-mounted drilling rig drilled 23 10-centimeter-diameter (3.5-inch) continuous soil cores to depths ranging from 10 to 15 m (34 to 49 ft) below ground surface.

3.3.2 Recorded Cultural Resources

Nine previously recorded archaeological sites and one isolated artifact are recorded within 0.25 mi of the proposed project area. Of these, five cultural resources are within or immediately adjacent to the creek restoration area (Table 3-7).

In addition, three previously unknown subsurface archaeological deposits were identified during surveys conducted for the proposed project (Table 3-7). These deposits are located at least 0.43 m (1.4 ft) below ground surface. An archaeological site record is currently being prepared for this site. Upon completion, the site record will be sent to the California Historical Resources Information System at UCSB, so that a Primary Number and Trinomial can be assigned to the site.

Table 3-7. Previously recorded resources within and adjacent to the archaeological study areas.

Resource	NRHP Status
CA-SBA-1009	Unevaluated
CA-SBA-1011	Unevaluated
CA-SBA-2696	Eligible
CA-SBA-3606	Unevaluated
CA-SBA-3607	Unevaluated
CA-SBA-3932*	Unevaluated
CA-SBA-3933*	Unevaluated
CA-SBA-3934*	Unevaluated

*Previously unknown

For purposes of this project only, the seven unevaluated resources are assumed eligible for the NRHP. Cultural resources within and adjacent to the proposed project area are described below.

CA-SBA-1009

CA-SBA-1009 was originally recorded in 1972 as a low-density scatter of marine shell and flaked stone artifacts visible in the vertical banks of San Antonio Creek (Spanne 1974). Subsequently, two shovel test pits excavated within site boundaries recovered only two pieces of marine shell at 20 centimeters (cm) (8 inches) below the surface (Greenwood and Foster 1981). No artifacts were observed on the ground surface at that time. During a survey of the San Antonio Creek banks in 2000, the surface deposit was found to be much as described in the 1972 site record (Lebow 2000). However, the cultural deposit exposed in the creek bank appeared to have a much higher density, suggesting the site is primarily buried and that cultural materials exposed on the surface have moved upward through post-depositional processes. Radiocarbon analysis of two samples collected during a survey in 2004 indicates the site was occupied around A.D. 390–450 (Lebow et al. 2007).

CA-SBA-1011

CA-SBA-1011 was originally recorded in 1972 as a low-density scatter of marine shell and flaked stone artifacts. Excavation of two shovel probes yielded only two pieces of marine shell (Greenwood and Foster 1981). During survey of the San Antonio Creek banks in 2000, two chert flakes and two marine shell fragments were observed on the sediment apron below the vertical bank (Lebow 2000). These items were slightly upstream from the site's recorded boundary, so the boundary was extended to the east to include these materials. No in situ cultural materials were observed in the creek bank. Radiocarbon analysis of three samples collected during a survey in 2004 indicates the site was occupied between about A.D. 120 and 360 (Lebow et al. 2007). No cultural

materials were observed at the site during the survey for the proposed project.

CA-SBA-2696

CA-SBA-2696 was originally recorded in 1994 during construction of the Coastal Branch Aqueduct (Price et al. 2006). Test excavations found the site was significant, and it was determined eligible for the NRHP in May 1995. Subsequent data recovery excavations focused on the aqueduct construction corridor (Colten et al. 1997). The uppermost 70 cm (2.3 ft) of soil is non-cultural alluvium. From 70 to 210 cm (2.3 to 6.9 ft) below surface, CA-SBA-2696 contains three distinct archaeological deposits in separate strata. Radiocarbon analysis revealed an initial occupation between 370 B.C. and A.D. 45, followed by a brief hiatus, and a second occupation between A.D. 105 and 340. The site was then abandoned, reoccupied, and abandoned for the last time around A.D. 590. The initial occupation was most intensive and occupants appear to have focused on hunting and processing large mammals. The subsequent occupation was less intensive and occupants focused more on hunting lagomorphs and less on large mammals. The final occupation was the least intensive, and occupants hunted both small and large mammals (Colten et al. 1997).

CA-SBA-3606

CA-SBA-3606 was originally recorded in 2000 along the northern bank of San Antonio Creek for approximately 70 m (230 ft) (Lebow 2000). Site contents include approximately 20 flakes, one projectile point fragment, 10 fire-altered rocks, three marine shell fragments, and one large-mammal long bone. Only a single marine shell fragment was observed in the creek cutbank in the upper 50 cm (20 ft), suggesting that the archaeological deposit is primarily on or near the surface (Lebow 2000). However, during a survey of the creek bank in 2004, archaeological remains were observed to a depth of 270 cm (9 ft) below ground surface (Lebow et al. 2007). Radiocarbon analysis of four marine shell fragments returned age determinations between 5600 and 3710 B.C.

CA-SBA-3607

CA-SBA-3607 was originally recorded during a survey of the San Antonio Creek banks in 2000 (Lebow 2000). It extends for approximately 70 m (230 ft) along the creek and was visible only in the southern bank of the creek bank approximately 2 m (6.6 ft) below the ground surface. Artifacts observed include three flakes, a large-mammal long bone fragment, and a large-mammal mandible fragment. No cultural materials were observed at this site during the 2004 survey (Lebow et al. 2007).

CA-SBA-3932

CA-SBA-3932 was identified during the Extended Phase-1 Archaeological Survey. Seven 10-centimeter-diameter (3.5-inch) auger holes encountered flakes, terrestrial mammal bone, fish bone, and shell remains from 2.1 to 5.5 m (6.9 to 18.0 ft) below ground surface within the 8.5-m (28-foot) thick block of floodplain that would be excavated at Bank Stabilization Site 1.

CA-SBA-3933

CA-SBA-3933 was identified during the subsurface archaeological survey on the north bank of San Antonio Creek within the proposed restoration area. The deposit is a subsurface archaeological midden that extends from 3.08 to 3.47 m (10.1 to 11.4 ft) below ground surface. Site constituents included flakes, terrestrial mammal bone, fish bone, and shell remains in fairly high densities. This was the densest deposit encountered during the subsurface archaeological survey.

CA-SBA-3934

CA-SBA-3934 was identified during the subsurface archaeological survey on the south bank of San Antonio Creek within the proposed restoration area. The site is a subsurface deposit located from 0.43 to 0.73 m (1.4 to 2.4 ft), 4.82 to 4.97 m (15.8 to 16.3 ft), and 10.82 to 11 m (35.5 to 36.1 ft) below ground surface. Site constituents include flakes and shell remains.

3.4 Earth Resources**3.4.1 Geology and Soils**

VAFB is a geologically complex area that includes the transition zone between the Southern Coast Range and Western Transverse Range geomorphic provinces of California. The geologic features of VAFB have been an important factor in the development of the diverse natural habitats found in this primarily undeveloped stretch of California coastline. VAFB is underlain predominantly by marine sedimentary rocks of Late Mesozoic age (140 to 70 million years before the present) and Cenozoic age (70 million years to the present). The basal unit underlying the entire base is the Franciscan Formation of upper Jurassic age (Dibblee 1950). The Franciscan Formation consists of a series of sedimentary and volcanic rocks with numerous serpentine intrusions. Extensive folding and faulting throughout the VAFB area has created four structural regions: the Santa Ynez range, the Lompoc lowland, the Los Alamos syncline, and the San Rafael Mountain uplift (Reynolds et al. 1985). The Santa Ynez range consists of a very thick Cretaceous-Tertiary sedimentary section uplifted along the Santa Ynez fault; it was then subsequently folded. The Lompoc lowland is an area of low relief that is structurally synclinal but has Franciscan basement relatively close to the surface. The Los Alamos syncline is a deep structural down warp traversing the Los Alamos and upper Santa Ynez valleys. Faulting along the southwestern margin of the mountain range uplifted the San Rafael Mountains. The majority of the folds in these structural regions are oriented to the northwest.

The two major riparian environments in the east/west trending valleys of VAFB are San Antonio Creek and the Santa Ynez River. The proposed project area is located within the San Antonio Valley along the north side of the Purisima Hills. The San Antonio Valley lies within the Santa Maria Basin-San Luis Range domain of central California, a

geologic transition zone between the Transverse Ranges Geomorphic Province to the south and the Coastal Ranges Geomorphic Province to the north. The region between these ranges is a structural depression, with Tertiary age rocks forming a series of broad folds (synclines and anticlines) with westward trending axes (Worts 1951).

A Sorrento-Mocho-Camarillo soil association, as are all river and creek areas on VAFB, characterizes the San Antonio Creek area. This soil type is found in nearly level to moderately sloping terrain such as floodplains and alluvial fans. This is a well drained to somewhat poorly drained soil, ranging from sandy loams to silty clay loams (Shipman 1981). It is composed of 40 percent Sorrento soils, 30 percent Mocho soils, 10 percent Camarillo soils, and 20 percent other soil series. The Sorrento series consists of well-drained sandy loams to clay loams, which are recent fluvial or alluvial deposits, and have a high to very high fertility. The erosion hazard is none to slight for Sorrento sandy loams and slight to moderate for Sorrento loams. The Sorrento series has a low to moderate shrink-swell potential. The Mocho series consists of well-drained alluvial and silty loams with a moderate to high fertility. It has a low to moderate shrink-swell potential and its erosion factor is none to slight. The Camarillo series consists of poorly drained, very fine-grained sandy loams to silty clay loams, which are alluvial in origin and have eroded from sandstone and shale bedrock. The fertility for the Camarillo series is moderate to high, there is no erosion hazard, and it has a low to moderate shrink-swell potential (Shipman 1972).

Subsurface conditions within the proposed project area generally consist of a variable thickness of existing fill, and alluvium overlying Sisquoc Formation and landslide deposits (Fugro 2006). The Sisquoc Formation typically consists of thickly bedded shale, siltstone and claystone, and weathers to a dark, clay rich soil at the ground surface that can be expansive and prone to landsliding. The alluvium and landslide

deposits consist of interbedded sand and clay. Weaker artificial fill and alluvium materials are prone to erosion.

Dibblee (1989) maps relatively large landslides along the north facing hillsides south of Hwy 1. A geotechnical study (Fugro 2006) conducted within the proposed project area reports some of the landslides may be larger than shown by Dibblee, and indicates the presence of active debris flows, surficial instability, and smaller landslides along the flanks of some of the larger landslides, particularly in the area upslope of Site 1 (Figure 2-1). If movement of the landslides or debris flows occurs in response to erosion, earthquakes or weather conditions, there is potential for the movement to impact the project area, Hwy 1, San Antonio Road West, and San Antonio Creek.

3.4.2 Seismology

The Santa Barbara County region is seismically active with a major earthquake occurring in the region about every 15 to 20 years (USAF 1987, Alterman et al 1994). The Santa Ynez-Pacifico Fault Zone, the Lompoc-Solvang (Santa Ynez River)-Honda Fault Zone, the Lions Head-Los Alamos-Baseline Fault Zones, and their potential offshore extensions, are three of the primary fault zones that project through VAFB (Alterman et al 1994).

These fault systems within the Transverse Ranges are considered active (Jennings 1994) and capable of generating damaging earthquakes. Moderate or major earthquakes along these systems could generate strong or intense ground motions in the area, and possibly result in surface ruptures of unmapped faults along the northern and southern boundaries, as well as the central part of VAFB.

3.4.3 Geological Hazards

The proposed project area within San Antonio Creek is located in a seismically active portion of Central California. Potential hazards that could affect the site and result in structural damage include faulting, ground shaking,

liquefaction, lateral spreading and flooding. The hazards consist of seismically induced settlement, and collapse (hydroconsolidation) potential.

The potential for surface fault rupture on VAFB is generally considered to be low (USAF 1987). At the present, there are no known areas where liquefaction has occurred. Areas most prone to liquefaction are those in which there is sandy to silty soil, the water table is within 50 ft of the surface, and earthquake loading exceeds 20 percent of gravity. The areas most prone to liquefaction on VAFB are near San Antonio Creek and the Santa Ynez River. The potential for liquefaction on VAFB, despite these areas, is still considered low (USAF 1987).

3.5 Hazardous Materials and Waste Management

Hazardous materials and wastes are those substances defined as hazardous by the Comprehensive Environmental Response, Compensation, and Liability Act, as amended by the Superfund Amendments and Reauthorization Act (42 U.S.C. 9601-9675); the Toxic Substances Control Act (15 U.S.C. 2601-2671); the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act (RCRA; 42 U.S.C. 6901-6992); and as defined in the State of California corresponding laws and regulations. In addition, federal and state Occupational Safety and Health Administration (OSHA) regulations govern protection of personnel in the workplace. In general, the definitions within the citations include substances that, because of their quantity, concentration, or physical, chemical, or infectious characteristics, may present substantial danger to public health and welfare, to workers, or the environment.

3.5.1 Hazardous Materials Management

VAFB uses approximately 5,000 hazardous materials items to accomplish its mission and mission support activities. The hazard

potential of the materials used range across the spectrum of toxicity. Users of hazardous materials must also comply with California Business Plan requirements. Management of hazardous materials used on VAFB follows procedures found in 30 SWP 32-7086, *Hazardous Materials Management Plan*. The Base Hazardous Materials Pharmacy (HazMart) maintains inventories of hazardous materials, whether purchased by the Air Force or its contractors. Before releasing hazardous materials to the user, HazMart staff ensures a copy of the Material Safety Data Sheet is available and verifies that the material is suitable for use on VAFB. By providing handling and use information, VAFB controls the potential misuse of hazardous materials, maintains an accounting of the types of hazardous materials used on Base, and accomplishes usage and emissions reports as required by federal, state, and local environmental regulations. Hazardous materials used during project activities include petroleum, oil, and lubricants (POLs) in equipment and vehicles.

3.5.2 Hazardous Waste Management

Management of hazardous waste at VAFB complies with the RCRA Subtitle C (40 CFR Part 240-299) and with California Hazardous Waste Control Laws as administered by the California EPA, Department of Toxic Substances Control, under Title 22, Division 4.5 of the California Code of Regulations (CCR). These regulations require that hazardous wastes be handled, stored, transported, disposed of, or recycled according to defined procedures. The VAFB *Hazardous Waste Management Plan*, 30 SWP 32-7043A, outlines the procedures to be followed for hazardous waste management.

Contractors generating hazardous wastes in support of a government contract are required to follow federal, state, and local laws and regulations, and use the Air Force Generator Identification Number to account for hazardous wastes generated. Because of the amount of hazardous waste generated per month under its Generator Identification

Number, VAFB is classified as a large quantity, fully regulated generator, required to comply with all laws regulating the generation, storage, transportation, and disposal of hazardous waste. VAFB employs a “cradle to grave” waste management approach. Hazardous waste is accumulated following rules applicable to either the larger quantity or small quantity generator status. Waste is transferred off-site in properly labeled Department of Transportation approved container from its point of origin to a permitted off-site treatment storage or disposal facility. The VAFB *Hazardous Waste Management Plan*, 30 SWP 32-7043A, provides detailed procedures for hazardous waste accumulation and management. Construction/demolition contractors would use the VAFB Generator Identification Number, and would have to comply with the VAFB *Hazardous Waste Management Plan*, 30 SWP 32-7043A. Hazardous waste is removed from VAFB under hazardous waste manifest and shipped off-site for final disposal.

3.5.3 Installation Restoration Program

The federal Installation Restoration Program (IRP) was implemented at Department of Defense facilities to identify, characterize, and restore hazardous substance release sites. There are currently 136 IRP sites throughout VAFB grouped into six Operable Units based on similarity of their characteristics.

IRP sites are remediated through the Federal Facilities Site Remediation Agreement, a working agreement between the USAF, the Central Coast Regional Water Quality Control Board (RWQCB), and the Department of Toxic Substances Control. In addition to IRP sites, there are identified Areas of Concern (AOCs), where potential hazardous material releases are suspected; and Areas of Interest (AOIs), defined as areas with the potential for use and/or presence of a hazardous substance. Various contaminants could be present at these sites including trichloroethylene, polychlorinated biphenyls, volatile organic compounds, total petroleum hydrocarbons, asbestos, and other hazardous

contaminants. No IRP sites, AOCs or AOIs have been identified within the proposed creek restoration area.

3.6 Human Health and Safety

The affected environment for Human Health and Safety includes those areas within VAFB where safety constraints associated with past and present VAFB mission and operations are in effect. It also includes the regulatory environment for health and safety issues established to minimize or eliminate potential risk to the general public and personnel involved in the restoration project under the Proposed Action.

3.6.1 Public Safety

Heavy flows along San Antonio Creek in February 1998 caused severe damage in several areas along the channel course, threatening the integrity of San Antonio Road West at several locations. Commuters traveling between VAFB and the community of Casmalia use San Antonio Road West on a daily basis. It is also one of the primary routes providing access to facilities on north Base. Risks to public safety resulting from potential road failure at the affected sites along San Antonio Road West exist under current conditions.

3.6.2 Worker Safety

Relevant health and safety requirements include industrial hygiene and ground safety. Industrial hygiene is the responsibility of the 30 SW Safety Office (30 SW/SE) and the 30th Medical Operations Squadron, Bioenvironmental Engineering Element (30 MDOS/SGOAB), and contractor safety departments. Responsibilities include monitoring and exposure to workplace chemicals and physical hazards, hearing and respiratory protection, medical monitoring of workers subject to chemical exposures, and oversight of all hazardous or potentially hazardous operations. Ground safety is the responsibility of 30 SW/SE and includes

protection from hazardous situations and hazardous materials. All construction activities and facility operations and maintenance on VAFB are subject to the requirements of the federal OSHA, and Air Force Occupational Safety and Health (AFOSH) regulations. Moreover, California OSHA has jurisdiction over non-federal operations south of Honda Ridge Road on south Base.

Hazardous materials, primarily POLs, would be used for operating equipment and vehicles, and for restoration activities under the Proposed Action. The potential exists for unexpected releases of these POLs, which would generate hazardous waste. Therefore, the potential exists for persons participating in project activities to become exposed to hazardous materials and hazardous waste. In addition, the following physical features have the potential to be present in the vicinity of project areas, and have the potential to adversely impact the health and safety of site workers:

- ▶ Physical hazards including traffic on the roads, holes and ditches, uneven terrain, sharp or protruding objects, slippery soils or mud, and unstable ground.
- ▶ Biological hazards such as animals (insects, spiders, and snakes), and disease vectors (ticks and rodents).

3.6.3 Noise

The Noise Control Act (NCA; 42 U.S.C. 4901 *et seq.*) sought to limit the exposure and disturbance that individuals and communities experience from noise. It focuses on surface transportation and construction sources, particularly near airport environments. The NCA also specifies that performance standards for transportation equipment be established with the assistance of the Department of Transportation. Section 7 of the NCA regulates sonic booms and gave the Federal Aviation Administration regulatory authority after consultation with the U.S. EPA. In addition, the 1987 Quiet Community amendment gave state and local authorities greater involvement in controlling noise.

Noise is often defined as unwanted sound that can interfere with normal activities or otherwise diminish the quality of the environment. Depending on the noise level, it has the potential to disrupt sleep, interfere with speech communication, or cause temporary or permanent changes in hearing sensitivity in humans and wildlife. Noise sources can be continuous (e.g., constant noise from traffic or air conditioning units) or transient (e.g., a jet overflight or an explosion) in nature. Noise sources also have a broad range of frequency content (pitch) and can be nondescript, such as noise from traffic or be specific and readily definable, such as a whistle or a horn. The way the acoustic environment is perceived by a receptor (animal or person) is dependent on the hearing capabilities of the receptor at the frequency of the noise, and their perception of the noise (URS Corporation 1986).

The amplitude of sound is described in a unit called the decibel (dB). Because the human ear covers a broad range of encountered sound pressures, decibels are measured on a quasi-logarithmic scale. The dB scale simplifies this range of sound pressures to a scale of 0 to 140 dB and allows the measurement of sound to be more easily understood.

There are many methods for quantifying noise, depending on the potential impacts in question and on the type of noise. One useful noise measurement in determining the effects of noise is the one-hour average sound level, abbreviated L_{eq1H} . The L_{eq1H} can be thought of in terms of *equivalent* sound; that is, if a L_{eq1H} is 45.3 dB, this is what would be measured if a sound measurement device were placed in a sound field of 45.3 dB for 1 hour. The L_{eq1H} is usually A-weighted unless specified otherwise. A-weighting is a standard filter used in acoustics that approximates human hearing and in some cases is the most appropriate weighting filter when investigating the impacts of noise on wildlife as well as humans. Examples of A-weighted noise levels for various common noise sources are shown in Table 3-8.

Another useful acoustical metric for describing sound events is the A-weighted sound exposure level (SEL). The A-weighted SEL is the total sound energy in a sound event *if that event could be compressed into one (1) second*. In essence, SEL is an average sound level that is condensed into 1 second. This provides a time-normalized metric and allows for analysis of events with different durations. As an example, an F-16 aircraft overflight (85 percent full power, altitude 210 ft, speed of 443 knots) was measured to have an A-weighted SEL of 113.1 dB (Berry et al. 1991).

The “peak sound level” is the greatest instantaneous sound level reached during a sound event. Peak levels also have various frequency weightings applied to them. Peak levels, though useful in some cases, can often be misleading. It can occur that a single peak in a complex waveform can be substantially greater than the majority of a sound event. Therefore, peak levels should

always be presented along with one or more of the metrics described above to better describe the sound event. An unweighted peak sound level is simply the peak sound level with no frequency weighting applied.

Existing noise levels on VAFB are generally quite low due to the large areas of undeveloped landscape and relatively sparse noise sources. Background noise levels are primarily driven by wind noise; however, louder noise levels can be found near industrial facilities and transportation routes. Rocket launches and aircraft over flights create louder intermittent noise levels. On VAFB, general ambient L_{eq1H} measurements have been found to range from around 35 to 60 dB (Thorson et al. 2001). Most activities associated with the Proposed Action would generate relatively continuous noise. Noise levels of typical heavy construction equipment, as would be used under the Proposed Action are presented in Table 3-9.

Table 3-8. Comparative A-weighted sound levels.

Noise Level (dBA)	Common Noise Levels	
	Indoor	Outdoor
100 – 110	Rock band inside New York subway	Jet flyover at 304 meters
90 – 100	Food blender at one meter	Gas lawnmower at one meter
80 – 90	Garbage disposal at one meter	Diesel truck at 15 meters; noisy urban daytime
70 – 80	Shouting at one meter; vacuum cleaner at three meters	Gas lawnmower at 30 meters
60 – 70	Normal speech at one meter	Commercial area heavy traffic at 100 meters
50 – 60	Large business office; dishwasher next room	
40 – 50	Small theater or large conference room (background)	Quiet urban nighttime
30 - 40	Library (background)	Quiet suburban nighttime
20 - 30	Bedroom at night	Quiet rural nighttime
10 - 20	Broadcast and recording studio (background)	
0 – 10	Threshold of hearing	

dBA = A-weighted Decibel.

Table 3-9. Noise levels of heavy construction equipment.

Equipment Item	Maximum Noise Level (dBA) at 15 m (50 ft)	Equipment Item	Maximum Noise Level (dBA) at 15 m (50 ft)
All other equipment > 5 Horsepower	85	Gradall	85
Auger Drill Rig	85	Grader	85
Backhoe	80	Horizontal Boring Hydraulic Jack	80
Bar Bender	80	In-situ Soil Sampling Rig	84
Boring Jack Power Unit	80	Jackhammer	85
Chain Saw	85	Paver	85
Compactor (ground)	80	Pickup Truck	55
Compressor (air)	80	Pneumatic Tools	85
Concrete Batch Plant	83	Pumps	77
Concrete Mixer Truck	85	Rock Drill	85
Concrete Pump	82	Scraper	85
Crane (mobile or stationary)	85	Slurry Plant	78
Dozer	85	Slurry Trenching Machine	82
Dump Truck	84	Soil Mix Drill Rig	80
Excavator	85	Tractor	84
Flat Bed Truck	84	Vacuum Excavator (vac-truck)	85
Front End Loader	80	Vacuum Street Sweeper	80
Generator (25 KVA or less)	70	Vibratory Concrete Mixer	80
Generator (more than 25 KVA)	82	Welder	73

dBA = A-weighted decibel m = meters ft = feet

SOURCE: Commonwealth of Massachusetts, Section 721.560 Construction Noise Control - <http://www.nonoise.org/resource/construc/bigdig.htm>

3.6.4 Unexploded Ordnance

Several areas on VAFB were used as ordnance training ranges and have the potential to contain unexploded ordnance (UXO). Since ordnance can be found in several areas on Base, the Explosive Ordnance Disposal (EOD) Flight must coordinate on all ground disturbing projects. According to EOD guidance, if ordnance is found on-site, it should not be disturbed. Workers in the vicinity must be alerted to the danger and directed away from it, and the EOD Flight must be contacted.

3.7 Land Use and Aesthetics

Visual resources and landscape elements on VAFB include natural features such as gently rolling hills, canyons, creeks, sand dunes, and beaches. Man-made features on Base include the airfield, launch pads, residential development, industrial facilities, and other structures typical of a military installation. Visual resource sensitivity is dependent on the type of user, the amount of use, and viewer expectations. Because the mission of VAFB is the development of U.S. space and missile programs, viewers are familiar with the existing man-made features on Base associated with these programs. San Antonio Creek lies partially within VAFB boundaries; however the stretch of the creek within the proposed project area can be accessed by

the general public (via Hwy 1, Lompoc-Casmalia Road, and San Antonio Road West) and is not within a restricted area.

VAFB accommodates agricultural outleasing as a major land use on Base. At present, 28,296 acres of rangeland are leased for grazing, and 1,661 acres for cropland (VAFB 2007). All grazing land and farmland at VAFB is currently leased to the U.S. Department of Justice, Bureau of Prisons, U.S. Penitentiary in Lompoc.

The area near the proposed project area is characterized by open space, with dryland farming and cattle grazing occurring within and adjacent to site. Other nearby land uses include a firing range and water treatment plant (Water Plant #2). The firing range is located on the south side of San Antonio Road West, east of Lompoc-Casmalia Road, and is used for weapons training of military personnel. No recreational use of the firing range is allowed. The water treatment plant is located south of the Lee Road Utility Bridge, across from San Antonio Road West, and includes water treatment and storage facilities.

The proposed restoration area lies within a portion of San Antonio Creek adjacent to San Antonio Road West, in a deeply entrenched meandering creek channel with lush mature willow riparian vegetation on the creek banks. Because the creek is so deeply cut into the San Antonio Valley floor, views of the creek bed and proposed project sites are only visible near the edge of the creek channel, or from Hwy 1, on a grade ascending the Purisima Hills.

Coastal Zone Management

Federal activity in, or affecting the California coastal zone, requires preparation of a Coastal Zone Consistency Determination or a Negative Determination, in accordance with the federal Coastal Zone Management Act of 1972. The California Coastal Zone Management Program was formed through the California Coastal Act of 1972. The Air Force is responsible for making final coastal zone consistency determinations for its

activities within the state. The California Coastal Commission reviews federally authorized projects for consistency with the California Coastal Zone Management Program.

On VAFB, the coastal zone extends inland from approximately 0.75 mi at the northern boundary to 4.5 mi at the southern end of Base. The project area under the Proposed Action is located approximately 3 mi inland, and is not within the California Coastal Zone. However, given potential, temporary, downstream effects during implementation the Proposed Action, the Air Force will request concurrence from the California Coastal Commission with a Negative Determination.

3.8 Transportation

VAFB is located approximately 5 mi west of the City of Lompoc. As shown in Figure 1-1 (Chapter 1), the main access route to VAFB is Hwy 101. Hwy 101 is a coastal four-lane divided freeway connecting northern California to southern California. The VAFB connections to Hwy 101 are Hwy 1, SR 135, and SR 246. Hwy 1, a north-south highway, traverses VAFB and provides access to Santa Maria to the northeast, and Santa Barbara to the southeast. When used in conjunction with Hwy 101, SR 246, an east-west highway, provides access to Lompoc to the east, and Santa Barbara to the southeast. SR 135 and SR 246 are mostly two-lane undivided highways with four-lane rural expressway portions.

Roadways in the vicinity of the project area lie within the jurisdiction of VAFB and the California Department of Transportation (Caltrans). These roadways include Hwy 1, San Antonio Road West, Richmond Road, and Sheridan Road.

VAFB is a federal military installation, and access to portions of Base is only permitted to authorized military personnel and their families, civilian employees of Base with approved identification, and visitors with pre-

approved authorization. Roadways within the project area are not restricted to public access, except during special military events or operations.

Exiting roadway conditions are evaluated based on roadway capacity and traffic volume. The capacity, which reflects the ability of the network to serve the traffic demand of a roadway, depends on the roadway width, number of lanes, intersection control, and other physical factors. A road's ability to accommodate different volumes of traffic is generally expressed in terms of Level of Service (LOS). The LOS scales range from A to F, with each level defined by a range of traffic volume to roadway capacity. LOS A, B, and C are considered good operating conditions with minor to tolerable delays experienced by motorists. LOS D represents below-average conditions. LOS E reflects a roadway at maximum capacity, and LOS F represents traffic congestion. Most roads on VAFB operate at a LOS between A and C (VAFB 2007).

Access to Project Site

The proposed creek restoration area is adjacent to San Antonio Road West. Project personnel and equipment would access this area via Hwy 1, turning onto San Antonio Road West from Hwy 1. San Antonio Road West is a 34-foot-wide, two-lane roadway with paved shoulders. This roadway is an east-west roadway that connects Hwy 1 with Lompoc-Casmalia Road. East of Lompoc-Casmalia Road, San Antonio Road West carries 733 average daily trips and operates in the LOS A range (USAF 2002). During the construction period, which is estimated to be 7 to 10 weeks, San Antonio Road West would be restricted to one lane.

Construction Trucks Haul Routes

The proposed creek restoration would require large quantities of imported stone, which would be obtained primarily from a borrow area located on Curly Road on north VAFB, and quarries located in Santa Margarita (San Luis Obispo County), and Corona (Riverside County). Currently, truck access to the Curly

Road borrow pit is through the Solvang Gate and Lompoc Gate. Truck traffic associated with the proposed project in the region (Santa Barbara County) would use Hwy 101, Hwy 1, SR 135, and SR 246. The proposed route for construction equipment to/from the restoration area is shown in Figure 3-2.

3.9 Water Resources

Water resources include surface water and groundwater and their physical, chemical, and biological characteristics. Surface water includes lakes, rivers, streams, and wetlands, while groundwater refers to water below the surface.

In California, the State Water Resources Control Board (SWRCB) and the RWQCB administer the state NPDES Program. Section 402 of the CWA mandates the NPDES program, and U.S. EPA regulations provide the authority and framework for state regulations. The NPDES Construction General Permit regulates construction sites of 1 acre or more in California, and ensures that water discharged from a site meets water quality standards. State regulations require a Waste Discharge Requirement (WDR) for permitting discharge.

The Central Coast RWQCB is the local agency responsible for the VAFB area. The Central Coast RWQCB Water Quality Control Plan (Basin Plan) provides a framework for establishing beneficial uses of water resources and the development of local water quality objectives to protect these beneficial uses.

The major freshwater resources of the VAFB region include six streams, comprising two major and four minor drainages. The major drainages are San Antonio Creek and the Santa Ynez River. The minor drainages include Shuman, Bear, Cañada Honda, and Jalama Creeks. San Antonio Creek and the Santa Ynez River are the primary collection basins for runoff from VAFB. Although their collection basins are extensive, flow in these

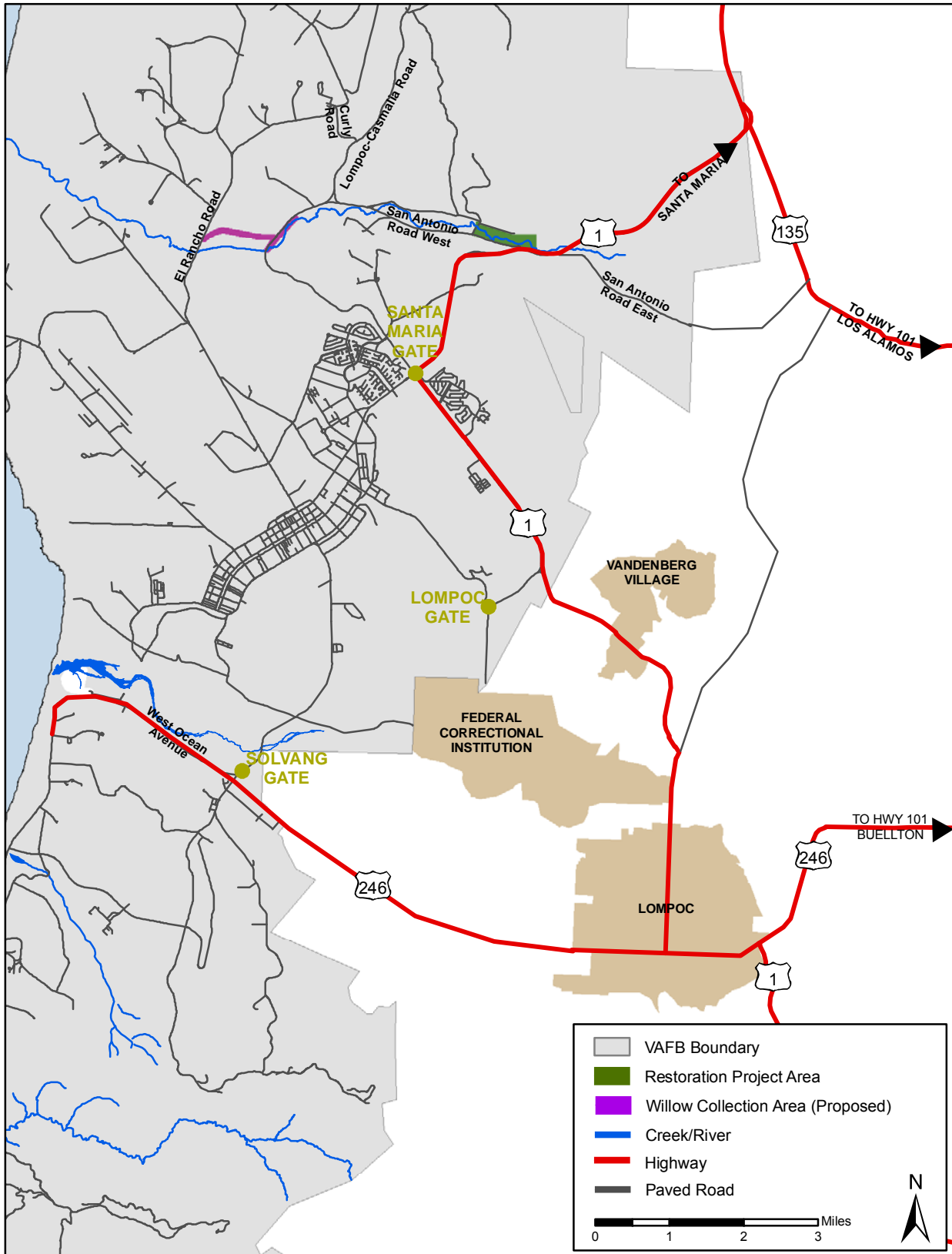


Figure 3-2. Main access and transportation routes associated with the Proposed Action.

two streams is seasonal because of low precipitation and upstream damming.

The general storm water rainy season at VAFB is from 1 October to 15 April. This timeframe has the greatest potential of site pollutant runoff. The average annual rainfall is approximately 14.8 inches (unpublished data, 30 SW).

3.9.1 Surface Water

San Antonio Creek drains an area of approximately 154 mi², flowing westward and discharging into the Pacific Ocean. The San Antonio Creek watershed consists of mostly undeveloped brushlands, rangelands, and agricultural fields.

Flow in San Antonio Creek is seasonal because of generally low precipitation from June to November. Higher discharges generally occur during the rainy season. The majority of the flow in San Antonio Creek is intermittent; however, the portion of the creek west of Barka Slough receives water emerging from groundwater seepage and has perennial flow due to a subsurface barrier, although at times very low. The amount of groundwater seepage into San Antonio Creek decreases as the amount of groundwater pumped in the upstream valley increases.

3.9.2 Sediment

The bed profile and channel shape of San Antonio Creek is actively changing between Barka Slough and the Pacific Ocean. Within the proposed project area, the creek channel has eroded and downcut (deepened through erosion) as much as 11 ft from 1993 through 2005 (HDR 2008). Peak sediment loads occur during the wet season due to the increased flow at that time.

3.9.3 Floodplain

The 100-year floodplain for the San Antonio Creek basin was defined by FEMA and is depicted in Figure 3-3.

3.9.4 Hydraulics

In 2002, Tetra Tech completed a hydraulic analysis of San Antonio Creek (Tetra Tech 2002). The analysis was based on annual peak flow data obtained from the USGS Water Resources Data Report for California Water Year 2003 (October 1, 2002 to September 30, 2003) from gage 11136100, located at the San Antonio Road West Bridge, approximately 1.6 mi upstream from the Lompoc-Casmalia Road Bridge. The drainage area upstream of the gage location is 135 mi².

Peak flows were determined using the Hydrologic Engineering Center Flood Frequency Analysis computer model for the 2-, 5-, 10-, 25-, 50-, and 100-year return period. Table 3-10 presents the peak discharges for various return-period storm events. The largest peak flow was recorded in February 1998 at 3,260 cubic feet per second (cfs; Table 3-11 [USGS 2008]).

Table 3-10. Peak flow rates at San Antonio Road West Bridge.

Return Period (Years)	Peak Flow (cfs)*
100	9,350
50	5,990
25	3,700
10	1,770
5	900
2	255

* cfs = Cubic feet per second

Table 3-11. Peak flows of San Antonio Creek at the San Antonio Road West Bridge from February 1998 to March 2003.

Month	Year	Total (cfs)*
February	1998	3,260
March	1999	332
February	2000	793
March	2001	2,740
November	2001	127
March	2003	178

* cfs = Cubic feet per second

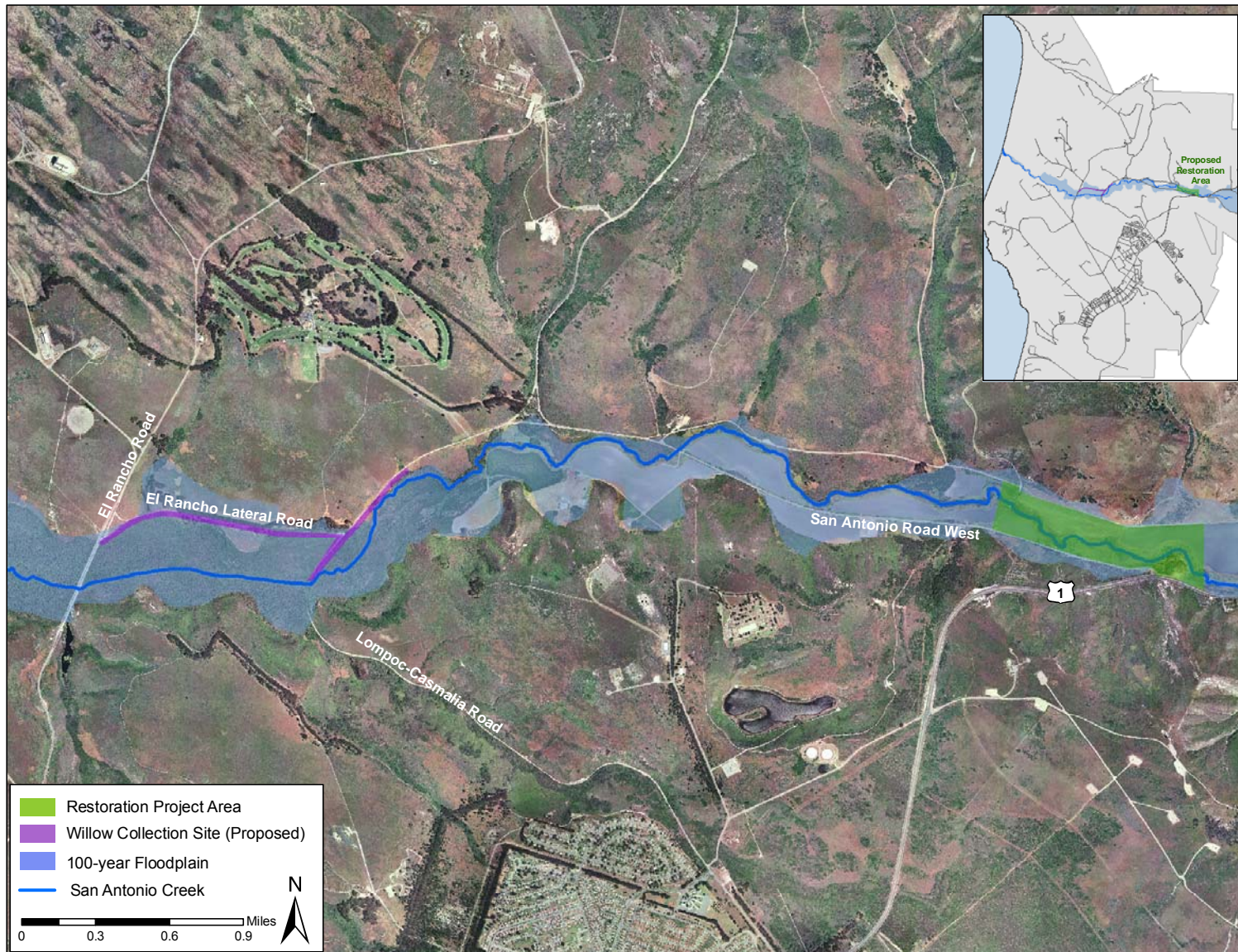


Figure 3-3. San Antonio Creek 100-year floodplain.

3.9.5 Groundwater

Groundwater in the San Antonio Creek Valley occurs in most of the unconsolidated deposits (deposits through which water flows easily) that have filled the San Antonio Trough (a notch cut through the consolidated Tertiary rocks by San Antonio Creek). The water-bearing deposits in San Antonio Creek include alluvium, Orcutt Sand, the Paso Robles Formation, and Careaga Sand.

Groundwater in the area moves from the hills surrounding the San Antonio Creek Valley toward the center of the valley, and from there west to the Pacific Ocean. At Barka Slough groundwater rises to the surface, creating a freshwater marsh, and flows westward into San Antonio Creek as surface flow. Within the proposed project area west of Barka Slough, the movement of groundwater is restricted to a thin, narrow strip of alluvium that has filled a notch cut through the consolidated Tertiary rock by San Antonio Creek.

Vineyards and other agricultural properties located upstream of VAFB draw water from the Paso Robles Formation and other unconsolidated formations. Groundwater levels within the proposed project area vary seasonally due to changes in runoff, storm conditions, and wells upstream that pump groundwater for irrigation. Stream flow during the wet season is derived primarily from rain runoff and tributaries. During the dry season the flow may be primarily derived from groundwater discharge from Barka Slough. The groundwater depth within the proposed project area is within 10 ft of the creek bed (Fugro 2006).

The groundwater downstream of Barka Slough is relatively high in hydrogen sulfide, with total dissolved solid (TDS) concentrations up to 2,430 milligrams per liter (mg/L), as measured from 2001 through 2003 (USGS 2008). These TDS concentrations are in excess of acceptable drinking water standards; however, the groundwater is suitable for drinking water purposes with the addition of chlorine and fluorine. In addition,

groundwater in this area has a sodium level that is beyond the limits for safe irrigation use (Muir 1964).

The VAFB water supply primarily comes from water purchased from the California Department of Water Resources State Water Project. Aquifers capable of yielding large quantities of water usable for water supply are generally restricted to the deeper portions of the Santa Ynez River and San Antonio Creek (USAF 1998). Four groundwater production wells located in the San Antonio Creek-Barka Slough area are used to supplement the VAFB state water during annual maintenance periods. The greatest threat to groundwater is contamination from hazardous material or waste releases that could infiltrate an aquifer. Groundwater from the San Antonio Creek basin supplies water for irrigation, domestic, industrial, and municipal purposes through pumping. The only local ground drinking water sources are the water wells located near Barka Slough, which are approximately 2 mi upstream from the creek restoration area.

3.9.6 Water Quality

Water quality objectives for water bodies within the Central Coast are established in the Central Coast RWQCB Basin Plan. The Central Coast RWQCB, through its Central Coast Ambient Monitoring Program, monitors water quality parameters in San Antonio Creek. Monitoring data is used to evaluate beneficial use support in the surface waters of the region. Main objectives are to evaluate the safety of surface waters for swimming, drinking, aquatic life, agricultural uses, and aesthetic and non-contact recreational uses. Healthy creek systems can be expected to carry sediment loads during high flows; thus, total suspended solids (TSS) will be elevated during storm events. Depressed dissolved oxygen (DO) levels typically are prevalent in summer and early fall when the temperatures are higher and water levels are low.

Water sample locations include the San Antonio Road West crossing of San Antonio Creek on VAFB, approximately 1 mi

downstream from the proposed creek restoration area. The mean TSS of 23 samples collected at this water sample location, from January 2001 through October 2004, was approximately 273 mg/L. The mean for DO of 26 samples collected between January 2001 and December 2004 was 9.4 mg/L. Detailed results and additional data on water quality in San Antonio Creek are accessible through the Central Coast Ambient Monitoring Program website at <http://www.ccamp.org>.

Section 303(d) of the federal CWA requires states to identify surface water bodies that are

polluted (water quality limited segments). These surface water bodies do not meet water quality standards even after discharges of wastes from point sources have been treated by the minimum required levels of pollution control technology. Wastewater treatment plants, a city's storm drain system, or a boat yard, are a few examples of point sources that discharge wastes to surface waters. San Antonio Creek is on the 2006 CWA Section 303(d) List of Water Quality Limited Segments. The creek is impaired due to sedimentation, ammonia, nitrate and boron.

Chapter 4. Environmental Consequences

This chapter presents the results of the analysis of potential environmental effects of implementing the Proposed Action and No-Action Alternative as described in Chapter 2. For each environmental component, anticipated impacts are assessed considering short- and long-term effects.

4.1 Air Quality

The criteria for determining the significance of air quality impacts are based upon federal, state, and Santa Barbara County standards and regulations. Impacts would be considered significant if project emissions increase ambient pollutant concentrations from below the NAAQS or CAAQS to above these standards, or if they contribute measurably to an existing or projected ambient air quality standard violation.

In non-attainment or maintenance areas, federal agencies are required to prepare a conformity determination to prevent federal actions from causing an exceedance of a national ambient air quality standard. To reduce the time and resources federal agencies expend in preparing conformity determinations, the U.S. EPA developed de minimis levels that serve as thresholds for focusing on those actions likely to have the most significant impacts. The U.S. EPA deemed that emission levels below the de minimis levels were not significant.

As of June 15, 2005, Santa Barbara is in attainment of all federal air quality standards, and federal agencies are no longer required to prepare conformity determinations. However, VAFB believes the threshold levels used in conformity determinations are still relevant for use as thresholds for determining if air quality impacts would be significant. The rationale used by the U.S. EPA to develop the

thresholds for non-attainment areas is no less applicable for areas in attainment. Although VAFB is no longer required to observe the significance levels required in conformity determinations, voluntary use of them provides a conservative approach to determining air quality impacts.

Maintenance areas have de minimis levels of 100 tons per year (tons/yr) for NO_x. The volatile organic compound (VOC) limits are 50 tons/yr for areas inside an ozone transport region and 100 tons/yr outside that region. Using a 365-day year, these de minimis levels equate to significance levels of 548 pounds per day (lbs/day) of NO_x and 274 or 548 lbs/day for VOCs for areas inside and outside of an ozone transport region, respectively. VAFB will apply the 100 tons/yr or 548 lbs/day VOC significance threshold. If Santa Barbara County becomes part of an Ozone Transport Region under the CAA, VAFB will reassess its VOC significance threshold. These are the levels, 100 tons/yr or 548 lbs/day of NO_x, or VOC, VAFB will use for determining whether or not air quality impacts are significant.

4.1.1 Proposed Action

The Proposed Action consists of installing in-stream rock-riffle grade controls at seven sites, and bioengineering bank stabilization at three of the grade control sites in San Antonio Creek, as detailed in Chapter 2 of this EA. Proposed construction activities are assumed to occur during calendar year 2008 and last for 40 days. Fugitive dust emissions generated from equipment operating on exposed ground and combustive emissions from the equipment would cause adverse air quality impacts. The largest adverse impacts would occur when vehicles disturb the soil on-site; smaller impacts would occur during the transport of construction debris and material handling. Factors needed to derive

construction source emission rates were obtained from the South Coast Air Quality Management District's (SCAQMD) *CEQA Air Quality Handbook* (SCAQMD 1999), and the CARB URBEMIS 2007 Model (Jones & Stokes Associates 2007), and EMFAC2007 BURDEN Model (CARB 2007).

The proponent prepared a list of construction equipment and anticipated usages, which was used to prepare the detailed air emission inventory presented in Appendix B. The construction equipment list is presented in Appendix B, Table B-1, while the emission factors used to estimate the emission are found in Table B-2. For purposes of this analysis, it was estimated that 1 acre per day would be disturbed. It was further estimated that on a reasonable worst-case day, 3 acres would be disturbed. With a disturbance of up to 10 hours per day, the reasonable worst-case day fugitive dust emissions would be 104.7 pounds (lbs) of PM₁₀ per day. These emissions would not be expected to cause an exceedance of any ambient air quality standard; therefore, there would be no significant impacts from PM₁₀.

The methodology and assumptions used to calculate emissions from the Proposed Action are presented in Appendix B. Tables B-3 and B-4 present the daily and total project emissions from construction activities, respectively. The daily emissions were estimated to be 153.27 lbs of CO, 438.64 lbs of NO_x, 126.77 lbs of PM₁₀, 29.98 lbs of ROC, and 0.43 lbs of SO_x. Total project emissions were estimated to be 2.40 tons of CO, 5.49 tons of NO_x, 1.02 tons of PM₁₀, 0.66 tons of ROC, and 0.01 tons of SO_x. Emissions from the Proposed Action would not exceed the significance thresholds of 548 lbs/day or 100 tons/yr. Therefore, no adverse impacts to the region's air quality should occur from the Proposed Action.

4.1.2 Environmental Protection and Monitoring Measures

Implementation of the environmental protection and monitoring measures outlined below should avoid or minimize potential

adverse effects to Air Quality during implementation of the Proposed Action. These measures are considered integral elements of the project description, and would be fully implemented.

- ▶ Before construction begins for the Proposed Action, portable equipment meeting the criteria defined in the *Final Regulation Order*, effective September 12, 2007 for the California Portable Equipment Registration Program would be registered in the program or have a valid SBCAPCD Permit to Operate.

- ▶ Portable diesel equipment would comply with the Airborne Toxic Control Measure for Diesel Particulate Matter from Portable Engines Rated at 50 horsepower and Greater, dated September 12, 2007.

- ▶ Equipment usage and fuel consumption would be documented and reported to the 30 CES/CEV to facilitate tracking construction emissions for inclusion in the VAFB Air Emissions Inventory.

- ▶ Idling of heavy-duty diesel trucks during loading and unloading shall be limited to 5 minutes, with auxiliary power units used whenever possible.

Although significant emissions would not occur from the Proposed Action, the following SBCAPCD dust control measures would be implemented to further decrease fugitive dust emissions from ground disturbing activities:

- ▶ Water would be applied at least twice daily to dirt roads, graded areas, and dirt stockpiles to prevent excessive dust at the staging areas. Watering frequency would be increased whenever the wind speed exceeds 15 mph. Chlorinated water would not be allowed to run into any waterway.

- ▶ Vehicle speeds would be minimized on exposed earth.

- ▶ Ground disturbance would be limited to the smallest, practical area and to the least amount of time.

- ▶ The Storm Water Pollution Prevention Plan (SWPPP), including Best Management Practices (BMPs) to reduce dust emissions,

and the Environmental Protection Plan (EPP), which includes dust control compliance measures, would be implemented.

- ▶ If importation, exportation, and stockpiling of fill material are involved, soil stockpiled for more than 2 days would be covered, kept moist, or treated with soil binders to prevent dust generation. Trucks transporting fill material to and from the site would be tarped from the point of origin.

In addition to the above dust control measures, the following control measures would be implemented to decrease diesel emissions. Diesel engines operated in California are required to meet CARB established standards which may be more stringent than federal mandates.

- ▶ When feasible, equipment powered with federally mandated ultra-low sulfur diesel engines would be used.
- ▶ Engine size in equipment used for the project would be minimized.
- ▶ The use of equipment would be managed to minimize the number of pieces of equipment operating simultaneously and total operation time for the project.
- ▶ Engines would be maintained in tune per manufacturer or operator specification.
- ▶ CARB-certified diesel fuel would be used.
- ▶ If feasible, U.S. EPA or CARB-certified diesel catalytic converters, diesel oxidation catalysts, and diesel particulate filters would be installed.
- ▶ CARB-developed idling regulations for trucks during loading and unloading would be followed.
- ▶ When applicable, equipment powered by diesel engines retrofitted or re-engined to meet the *Air Toxics Control Measures for Off-Road Vehicles* would be used.
- ▶ Given the requirements of EO 13423, *Strengthening Federal Environmental, Energy, and Transportation Management*, and the increasing concerns that greenhouse gases contribute to Global Climate Change, the 30 CES/CEV will take into consideration

and encourage measures that promote efficiency and conservation through education, programs, and incentives to increase efficiency and conserve energy in projects on VAFB.

4.1.3 No-Action Alternative

Under the No-Action Alternative, there would be no activities associated with creek restoration. Therefore, no impacts to air quality would occur as a result of emissions associated with project activities.

4.2 Biological Resources

Impacts to biological resources would occur if special status species (i.e., endangered, threatened, rare, or candidate) or their habitats, as designated by federal and state agencies, would be directly or indirectly affected by project-related activities. In addition, impacts to biological resources are considered adverse if substantial loss, reduction, degradation, disturbance, or fragmentation would occur in native species habitats or in their populations. These impacts can be short- or long-term impacts, such as short-term impacts from noise and dust during construction, and long-term impacts from the loss of vegetation and, consequently, loss of the capacity of habitats to support wildlife populations.

4.2.1 Proposed Action

The Proposed Action would potentially result in disturbance to approximately 105.49 acres within the restoration area. In addition, willow collection would occur within approximately 22.35 acres of willow riparian habitat near the El Rancho Lateral Road-Lompoc Casmalia Road intersection. Project activities would last approximately 7 to 10 weeks. These activities have the potential to result in short-term, temporary, adverse effects to biological resources in the immediate area of disturbance, and long-term, permanent, beneficial effects from improved habitat and ecological function. Specific effects of

implementing the Proposed Action on botanical and wildlife resources are discussed in more detail below, and potential related effects to special status species are summarized in Table 4-1. Measures to minimize or avoid adverse effects on natural resources and special status species during project implementation are summarized in Section 4.2.2, Environmental Protection and Monitoring Measures.

4.2.1.1 Botanical Resources

Potential effects to plant communities and plant species include:

- ▶ Short-term (temporary) and long-term (permanent) loss of habitat from construction

related activities such as access, excavation, and placement of rock riprap.

- ▶ Loss of individuals within project areas due to excavation, crushing or burial.
- ▶ Loss of individuals in habitats adjacent to work areas due to soil erosion.
- ▶ Soil erosion in wetlands or open water within and adjacent to the restoration area.
- ▶ Long-term increase of habitat value.

Approximately 86.56 acres of natural vegetation types occur within the proposed restoration and willow collection areas, and have the potential to be affected as a result of

Table 4-1. Potential Proposed Action related effects on special status species.

Scientific Name Common Name	Status		Occurrence	Potential Effects
	USFWS ¹	CDFG ²		
Plants				
<i>Deinandra increscens</i> ssp. <i>villosa</i> Gaviota tarplant	FE	SE	Potential	Loss of individuals and seed bank.
Fishes				
<i>Gasterosteus aculeatus williamsoni</i> Unarmored threespine stickleback	FE		Documented	Temporary decrease of habitat quality due to turbidity; entrapment in project area. Long-term increase in availability of quality habitat.
Amphibians				
<i>Rana aurora draytonii</i> California red-legged frog	FT	CSC	Documented	Temporary loss of habitat; disturbance due to noise; entrapment in project area; temporary decrease of habitat quality due to turbidity. Long-term increase in availability of quality habitat.
Invertebrates				
<i>Euphilotes battoides allyni</i> El Segundo blue butterfly	FE		Potential	Loss of eggs, larvae, and pupae, and host plant seaciff buckwheat.
Birds				
<i>Agelaius tricolor</i> Tricolored blackbird	BCC	CSC	Documented	Disruption of foraging and roosting activities. Long-term increase in availability of quality habitat.
<i>Lanius ludovicianus</i> Loggerhead shrike	BCC	CSC	Documented	Disruption of roosting and foraging activities.
Reptiles				
<i>Actinemys marmorata</i> Western pond turtle		CSC	Documented	Disruption of resting and foraging activities. Long-term increase in availability of quality habitat.

NOTES:

1 FE = Federal Endangered Species FT = Federal Threatened Species BCC = Federal Bird of Conservation Concern

2 SE = California Endangered Species CSC = California Species of Concern

project activities. Temporary disturbances to these vegetation types would be unavoidable during installation of temporary access roads and staging areas, installation of grade control and bank stabilization structures, excavation of floodplain terraces, and collection of branch cuttings.

Vegetation greater than 2.5 inch-diameter would be mechanically cleared and smaller vegetation (less than 2.5-inch-diameter) would be crushed. To the extent feasible and possible, root systems would be left intact. Native topsoil and subsoil would be salvaged during excavation and grading, except in areas with a seed bank likely dominated by undesirable weed species. Soil excavated within the project area would be used as fill within project sites to minimize introducing non-native soils into the creekbed.

Removal of vegetation, and temporary disturbances to natural vegetation types would be necessary during project implementation, and considered a significant impact without mitigation. However, the removal of native vegetation would be minimized, and native vegetation would be replanted to restore all disturbed areas. As much as feasible, vegetation removal would be restricted to the minimum areas possible, and restricted to the level of the bottom substrate, with root systems left in place to encourage vegetation re-sprouting after completion of construction activities. In addition, BMPs required as part of the NPDES Construction General Permit would be implemented to control erosion and reduce turbidity during construction.

Live branch cuttings would be incorporated during construction and restoration of native vegetation types would be implemented during project activities. Areas disturbed by construction activities would be restored to an ecologically functional state that supports the same local plant and animal species found in adjacent natural areas. Maintenance (e.g., weeding and re-seeding) and monitoring would ensure the successful restoration of native vegetation types and wetland habitats, to the maximum extent possible. Areas

proposed for restoration under the Proposed Action are expected to return to self-sustaining native vegetation types. Therefore, impacts to botanical resources should be less than significant.

4.2.1.2 Wildlife Species

The potential adverse effects to wildlife species associated with the Proposed Action include:

- ▶ Short-term (temporary) and long-term (permanent) loss of habitat from construction related activities such as access, excavation, and removal of vegetation.
- ▶ Loss of individuals within the work area due to excavation, crushing or burial.
- ▶ Loss of individuals in habitats adjacent to work areas due to soil erosion.
- ▶ Short-term (temporary) abandonment of roosting sites due to project-related noise and associated disturbance.
- ▶ Disruption of foraging or roosting activities due to project-related noise and associated disturbance.
- ▶ Soil erosion into open water adjacent to the project site.
- ▶ Degradation of water quality due to turbidity.
- ▶ Long-term (permanent) benefits from improved habitat and a healthier riparian ecosystem.

Wildlife, including mammals, amphibians, reptiles, and birds, present in the vicinity of the restoration activities could be affected by project-generated noise. Wildlife response to noise can be physiological or behavioral. Physiological responses can range from mild, such as an increase in heart rate, to more damaging effects on metabolism and hormone balance. Behavioral responses to man-made noise include attraction, tolerance, and aversion. Each has the potential for negative and positive effects, which vary among species and individuals of a particular species, due to temperament, sex, age, and prior experience with noise. Responses to

noise are species-specific; therefore, it is not possible to make exact predictions about hearing thresholds of a particular species based on data from another species, even those with similar hearing patterns.

Potential impacts to wildlife species from human presence, project-generated noise, and disturbance associated with project implementation include temporary disruption of foraging and roosting activities and loss of habitat. Wildlife species would be expected to move away from the areas of disturbance during restoration activities. These disturbances would be considered short-term and temporary, and would not be considered of a magnitude to result in adverse impacts to populations within the vicinity of the project areas, given the availability of ample habitat available in the surrounding areas. Areas proposed for restoration under the Proposed Action are anticipated to return to natural vegetation types, and wildlife species are expected to return to these areas.

The Migratory Bird Treaty Act provides federal protection to native avian species, their nests, eggs, and unfledged young. Restoration activities would occur from approximately August 25 to October 15, which is past the breeding season for avian species known to breed within the project area.

4.2.1.3 Sensitive Vegetation Types and Special Status Species

The proposed restoration project would result in the temporary disturbance of riparian and wetland habitat within the creek bed and banks due to project-related activities. A wetland delineation was completed in April 2008 that provides accurate acreages of disturbance to these habitats (Appendix D). Section 4.2.1.4 below provides additional details on impacts to these vegetation types. These areas are proposed for habitat restoration and are anticipated to return to natural plant communities.

Formal section 7 consultation for federally listed species with potential to be affected is presently underway. The resulting Biological

Opinion, and Terms and Conditions contained therein, will be incorporated into the Final EA.

Unarmored Threespine Stickleback and California Red-legged Frog

Changes in water flow, draining of areas with ponded water, increases in sedimentation, and removal of riparian vegetation have the potential to adversely impact unarmored threespine stickleback and California red-legged frog habitat. The water quality and quantity, substrate, and vegetative overstory, have the potential to be affected within and downstream of the project area. The Air Force proposes to minimize the release of fine sediments during construction by implementing appropriate erosion control measures.

The proposed project may disrupt and reduce the prey base of unarmored threespine sticklebacks and California red-legged frogs. Temporary pulses of suspended sediment during construction may cover algae and suffocate bottom dwelling organisms. Subsequently, a reduction in prey species may lead to increased competition for food. Proper implementation of methods to reduce sedimentation would reduce impacts to the prey base.

Contamination of unarmored threespine stickleback and California red-legged frog habitat may occur during the application of soil binders, mulch, tackifiers, and fertilizers; spills and leaks from construction equipment; or discharge of construction related materials into the creek channel. The fertilizer Biosol® is not water soluble, and the nitrogen is unavailable for water transport. This fertilizer is released biologically to the plants and not the soil (Rocky Mountain Bio Products 2008). Additionally, the Air Force proposes to implement measures to minimize erosion and the possibility of accidental spills into waterways. Pipes used for temporary containment of creek flows would be capped off and buried under construction materials during project implementation, or to a depth to prevent scour after project activities. Implementation of minimization measures during project activities should minimize the

potential for adverse effects, while restoration of riparian and upland habitat and revegetation of disturbed sites within the project area should provide beneficial effects to California red-legged frogs and unarmored threespine stickleback.

Unarmored threespine sticklebacks and California red-legged frogs would be captured and relocated prior to project implementation. Thus, adverse effects to these species would be minimized. California red-legged frogs in the vicinity of project sites would be expected to move away from the areas of disturbance during restoration activities. These disturbances would be considered short-term and temporary and would not be considered of a magnitude to result in adverse impacts to populations within the vicinity of the project area.

California red-legged frogs and unarmored threespine sticklebacks may be injured or killed during capture and relocation efforts, by foot or equipment traffic, predators attracted to work areas, or as a result of contamination of habitat. Pre-construction surveys would be conducted for unarmored threespine stickleback within the restoration area to determine approximate population estimates and quantify the effects of the proposed project on this species. The proposed minimization measures should ensure that California red-legged frogs and unarmored threespine sticklebacks are protected, and that potential for injury is averted as much as possible.

El Segundo Blue Butterfly

Surveys have not been conducted during the flight period for El Segundo blue butterfly (June through September) in the vicinity of the project area, thus it is unknown whether this species occurs within or near the area. Surveys would be conducted within known occupied habitat on VAFB to determine the 2008 flight period. Pre-construction surveys would be conducted within the project area during this period to positively identify the presence of this species and quantify the effects of the proposed project.

Project activities would occur between approximately August 25 and October 15, partially during the flight period for the El Segundo blue butterfly (June through September), and could result in disturbance and mortality of adult butterflies. The destruction of seaciff buckwheat during the June through September period when eggs or larvae may be present could result in mortality of these life stages. Vehicle traffic and other activities causing soil compaction have the potential to crush diapausing pupae. Adverse effects to butterfly adults, eggs, larvae and pupae, if present, and to its host plant, seaciff buckwheat, would be avoided by isolating and protecting individual plants from disturbance.

Gaviota Tarplant

Activities associated with the proposed creek restoration that could adversely affect Gaviota tarplant include excavation, installation of access roads and staging areas, and disturbance as a result of vehicles driving over the plants for access to project sites. Because restoration activities would partially occur during the flowering period for Gaviota tarplant (May to September), potential adverse effects associated with these activities include loss of individual Gaviota tarplants and their seeds.

Because Gaviota tarplant could not be positively identified due to absence of flowers during the biological surveys for this project, precise estimates of affected Gaviota tarplant habitat could not be calculated. Gaviota tarplant may occur in low quality habitat represented by the ruderal community within the project area, which is subject to continuous disturbance such as road maintenance. Approximately 0.04 acre of suitable Gaviota tarplant habitat was identified as having the potential to be affected by the proposed project. Pre-construction surveys would be conducted during the peak blooming period (June through September) at all project sites to positively identify the presence of this species and quantify the effects of the proposed project.

Individual plants documented during these surveys would be isolated and protected from

disturbance, if possible. Individual plants present within these areas may be permanently lost, and the seed bank disturbed, which could delay or prevent the reestablishment of plants. However, individuals that occur within this ruderal habitat are isolated from high quality suitable habitat by nature of their location, and are restricted to a long, narrow corridor with no opportunity for expansion. Due to the small number of individuals that could be lost, and extensive distribution of *Gaviota tarplant* on VAFB, the loss of individuals and low quality habitat within the proposed restoration area is unlikely to result in adverse effects to the species. Restoration of native vegetation types would be implemented during project activities.

Tricolored Blackbird and Loggerhead Shrike

Breeding activities of these avian species would not be disrupted due to the time of year when the project would be implemented. Disturbances resulting from the presence of human activity would disrupt roosting and foraging activities if birds are present within the project area. These disturbances would be short-term, and additional suitable habitat not subject to these temporary disturbances is available in the vicinity; thus, adverse effects should be less than significant.

Western Pond Turtle

Project activities would occur at the end of the breeding period for this species, thus it is unlikely that breeding activities would be affected. Western pond turtles may be present within project sites resting and foraging. Disturbances resulting from human presence would temporarily disrupt these activities. Additional suitable habitat not subject to these disturbances is available in the vicinity, thus adverse effects should be less than significant.

4.2.1.4 Waters of the United States and Wetlands

Impacts to jurisdictional waters of the U.S. and wetlands are considered significant if the project results in a net loss of wetland area or

habitat value, either through direct or indirect impacts to wetland vegetation, loss of habitat for wildlife, degradation of water quality, or alterations in hydrological function.

Based on the wetlands delineation conducted from February through April 2008 (MSRS 2008) and the footprint for disturbance for the proposed project, it is anticipated that the Proposed Action would result in the direct disturbance of 4.75 acres of Waters of the U.S., including 3.18 acres of wetland habitat (freshwater marsh). A CWA Section 401 Water Quality Certification from the Central Coast RWQCB and CWA Section 404 Permit from the USACE would be required because direct impacts to water bodies or wetlands would occur. Live branch cuttings would be incorporated during construction and restoration of vegetation types would be accomplished during project implementation. Bank stabilization, including creation of floodplain terraces, would create an enhanced wetland habitat within the proposed restoration area. However, preliminary estimates based on GIS analysis indicate approximately 0.67 acre qualifying as USACE jurisdictional wetland would be lost due to project implementation. Actual net gain/loss would be calculated upon completion of the project and mitigation measures would be developed and implemented, if required for any losses. With these measures, impacts should be less than significant.

4.2.2 Environmental Protection and Monitoring Measures

Implementation of the environmental protection and monitoring measures outlined below should avoid or minimize potential adverse effects to Biological Resources during implementation of the Proposed Action. These measures are considered integral elements of the project description, and would be fully implemented.

- Qualified biologists would brief all project personnel prior to participating in project implementation activities. At a minimum, the training would include a description of the listed species occurring in the area, and the

general and specific measures and restrictions to protect these species during project implementation, i.e., work area boundaries, access routes, and staging areas.

- ▶ All human generated trash at the project area would be contained and removed from the work site and disposed of properly at the end of each workday. All construction debris and trash would be removed from the project area upon completion of the project.

- ▶ All brush piles resulting from vegetation removal would be removed from the creek bed by the end of each workday.

- ▶ A schedule of planned construction activities would be provided to the VAFB Biologist and Botanist, and the biological monitors, at least 48 hours in advance.

Botanical Resources

- ▶ Pre-construction surveys would be conducted during the peak blooming period (June through September) to positively identify the presence of Gaviota tarplant within the project area. Individual plants documented would be isolated and protected from disturbance, if possible.

- ▶ Where feasible, non-native wetland and riparian vegetation within the project area would be removed during project-related activities.

- ▶ All temporarily disturbed areas, including access roads, would be restored at a minimum to the original condition.

Wildlife Resources

- ▶ Temporary containment of the active creek channel would occur through or around a project site, ensuring unimpeded creek flow through the project area.

- ▶ Approximately 1 week prior to containment of the creek channel, a qualified biologist would install exclusion nets and drift fencing to exclude unarmored threespine stickleback, California red-legged frogs, and other aquatic species from the project area.

- ▶ Exclusion nets would be set up within the main channel of San Antonio Creek approximately 50 ft upstream and 50 ft downstream of the project area. Exclusion nets would be checked daily to remove debris and ensure netting is still in good condition.

- ▶ Silt fencing, or other similar material, would be used to construct drift fences within the main channel of San Antonio Creek, approximately 50 ft upstream and 50 ft downstream of the project area, to exclude adult and sub-adult California red-legged frogs. Drift fences would be securely anchored at the bottom.

- ▶ After installation of the nets and drift fences, and within 2 days prior to construction activities, unarmored threespine stickleback, all lifestages of the California red-legged frog, and other aquatic species within the exclusion zone, would be captured and relocated downstream of the project area. The main channel of San Antonio Creek, as well as all side channels and isolated pools within the exclusion zone, would be repeatedly searched for these species.

- ▶ When possible, capturing and releasing of adult and sub-adult California red-legged frogs would be conducted during night surveys prior to construction activities, between 1 hour after sunset and midnight, during the period when California red-legged frogs are most active.

- ▶ Dipnets and minnow traps would be used to capture any overwintering California red-legged frog tadpoles around vegetation.

- ▶ Qualified biologists, approved by the USFWS and 30 CES/CEV, would be present to inspect work areas prior to the start of activities each day, and capture and relocate any unarmored threespine stickleback, California red-legged frogs, or other aquatic species that may be present.

- ▶ A screen (no larger than 0.125-inch mesh size) would be installed at the end of dewatering pumps to prevent entrapment of unarmored threespine stickleback and California red-legged frogs.

- ▶ California red-legged frogs and unarmored threespine sticklebacks captured during project activities would be transported and relocated to suitable habitat outside of the project area.
- ▶ Unarmored threespine stickleback would be monitored downstream of the project area before and intermittently during construction to assess possible downstream impacts.
- ▶ A contingency plan would be developed for the recovery and salvage of unarmored threespine stickleback, and California red-legged frogs, in the event of a local toxic spill or accidental dewatering of their habitat.
- ▶ To the maximum extent feasible, individuals of non-native species, such as bullfrogs, crayfish, and the centrarchid fishes, would be removed from the project area.
- ▶ Seacliff buckwheat, host plant of the El Segundo blue butterfly, would be isolated and protected from disturbance.

4.2.3 No-Action Alternative

Under the No-Action Alternative, restoration activities would not occur within San Antonio Creek on VAFB, and biological resources would not be directly affected by project activities. Implementation of this Alternative would result in significant long-term adverse effects on biological resources. Adverse effects to botanical and wildlife resources, including special status species, include the continued incision of the creek bed and banks, and further decline in the quality and quantity of native plant communities and wildlife habitat.

4.3 Cultural Resources

The Proposed Action is subject to compliance with all relevant authorities governing cultural resources, including Section 106 of the NHPA and Air Force Instruction (AFI) 32-7065. Compliance with Section 106 of the NHPA also satisfies federal agencies responsibilities for considering potential project related effects to cultural resources under the NEPA.

Section 106 of the NHPA requires federal agencies to consider the effects of proposed federal undertakings on cultural resources that are listed in or eligible for listing in the NRHP (a.k.a. historic properties). Part of compliance with Section 106 requires the federal agency to determine either that the undertaking would have no effect to historic properties, no adverse effect to historic properties, or an adverse effect to historic properties (which would then require resolving). The Section 106 implementing regulations [36 CFR Part 800] prescribe the process for making these determinations.

4.3.1 Proposed Action

A complete inventory of cultural resources was performed within the proposed creek restoration area. The cultural resources investigation was a coordinated review that meets the requirements of Section 106 of the NHPA, and the NEPA.

Project activities were developed to avoid adverse effects to known resources, where feasible. However, one archaeological site (CA-SBA-3932) could not be avoided. Because the site is deeply buried, VAFB assumes the site is eligible for the NRHP for the purposes of the proposed project only. Therefore, VAFB has determined that the Proposed Action would have an adverse effect to one historic property. This determination and the associated studies are documented within a report on the identification of historic properties and assessment of adverse effects, which was submitted to the California State Historic Preservation Officer (SHPO) for review and a request for concurrence.

VAFB will seek measures to mitigate the project's adverse effects to acceptable levels with the SHPO and Santa Ynez Band of Chumash Indians, in compliance with Section 106 of the NHPA and AFI 32-7065. These measures will be contained within a Historic Property Treatment Plan, accompanied by a Memorandum of Agreement (MOA). Upon signature of the MOA by consulting parties, the terms outlined in the Historic Property

Treatment Plan would be fully implemented. In the event that previously undocumented cultural resources are discovered during project activities, procedures established in 36 CFR 800.13 would be followed.

The following sections discuss the consequences of implementing the Proposed Action on each cultural resource.

CA-SBA-1009

Project activities near CA-SBA-1009 would include the establishment of a temporary construction access road that runs from Sheridan Road southward across the agricultural field and through the middle of the site. The construction access road limits would be designated using orange mesh temporary fencing, stakes, or other readily visible marker as appropriate. Additionally, in the western edge of the site, there would be a boulder storage and delivery area. Dump trucks would deposit boulders onto the ground surface and an excavator with a “thumb” on the bucket would pick the boulders up and lower them into the creek bed, where another excavator would receive the boulder and deliver it to its final location. When construction is complete, all temporary work areas would be restored to their original condition to the maximum extent feasible and revegetated.

Three shovel test pits excavated along the proposed construction access road revealed a very low-density scatter of flaked stone debitage. It is most likely that these artifacts were transported upwards from a more deeply buried deposit by post-depositional processes. VAFB is assuming CA-SBA-1009 is eligible for the NRHP for the purposes of this project only. Given this assumption, the archaeological remains within the uppermost meter of soil would not contribute to the eligibility of the archaeological site. Geotextile fabric and gravel would be placed along the proposed access road and boulder delivery and storage area to afford the site the greatest protection possible. When project construction is completed, the gravel and geotextile fabric would be removed. These

measures would avoid impacts to site CA-SBA-1009.

CA-SBA-1011

Project activities near CA-SBA-1011 would include the establishment of a temporary construction access road that runs from Sheridan Road southward across the agricultural field and along the eastern boundary of the site, which then turns west to run down the creek bank into the bottom of the creek. The construction access road limits would be designated using orange mesh temporary fencing, stakes, or some other readily visible marker, as appropriate. Additionally, in the area southeast of the site, there would be a boulder storage and delivery area. When project construction is complete, all temporary work areas would be restored to their original condition to the maximum extent feasible and revegetated. Impacts to CA-SBA-1011 would be completely avoided by erecting orange-mesh temporary fencing around the site prior to construction to keep equipment and personnel out of the site.

CA-SBA-2696

Project activities near CA-SBA-2696 would include the establishment of Lee Road as the construction access route. Lee Road runs north-south across CA-SBA-2696; however, it is a former paved road that is built up above the surrounding agricultural fields. At the north end of this segment of Lee Road, a boulder storage and delivery area would be set up on the east side of Lee Road, just beyond the edge of the northern site boundary of CA-SBA-2696. When project construction is complete, all temporary work areas would be restored to their original condition to the maximum extent feasible and revegetated.

Impacts to CA-SBA-2696 would be completely avoided by keeping equipment out of site boundaries. Equipment travel would be restricted to Lee Road, and orange-mesh temporary fencing would be erected between the north site boundary of CA-SBA-2696 and the boulder storage and delivery area.

CA-SBA-3606

Project activities near CA-SBA-3606 include the establishment of a temporary construction access road that runs from Sheridan Road southward across the agricultural field and west of the site down into the creek bottom. Further west, a boulder storage and delivery area would be established. When project construction is complete, all temporary work areas would be restored to their original condition to the maximum extent feasible and revegetated. Impacts to CA-SBA-3606 would be completely avoided by erecting orange-mesh temporary fencing along the western margin of the site to form a barrier between the construction access route and the site.

CA-SBA-3607

Project activities near the site would include rebuilding the south creek bank with compacted fill material. This process would add more soil cover to CA-SBA-3607, thereby making the existing natural cap even thicker. Impacts to the site would be completely avoided as a result of the type of activities planned in this location. No other avoidance measures are required for this work location.

CA-SBA-3932

Project activities in this area include moving the creek thalweg approximately 30 m (100 ft) northward away from the creek bank below San Antonio Road West, and rebuilding the south creek bank with compacted fill material. A large portion of the floodplain would be excavated on the northern bank of the creek. This portion of the floodplain contains CA-SBA-3932.

The floodplain terrace is a key aspect of the proposed project. Avoidance would negate the project's overall purpose and need because the project would not be able to accomplish the desired restoration objectives. Additionally, there are no prudent and feasible project design modifications that could be adopted that would appreciably save this portion of CA-SBA-3932. The proposed project would have an adverse effect to this resource.

CA-SBA-3933

Project activities proposed in the vicinity of CA-SBA-3933 include construction of a grade control structure and temporary access route that runs from Sheridan Road southwest across the agricultural field to the west of the site. This route turns south and down the creek bank into the bottom of the creek bed. Excavation is not required to achieve a 10H:1V slope as the route descends the creek bank. Additionally, a boulder storage and delivery area would be established at the edge of the creek bank. Although the boulder storage area is near CA-SBA-3933 in the horizontal plane, it is separated vertically by 3.08 m (10.1 ft) of non-cultural soil. Therefore, there would be no impacts to CA-SBA-3933, and no avoidance measures are required for this site.

CA-SBA-3934

Project activities in this area include construction of a grade control structure. Key trenches would be excavated up the creek bank to the 100-year flood level. It is highly unlikely that *in situ* archaeological deposits exist in areas where key trenches would be located. The Proposed Action would not affect CA-SBA-3934.

4.3.2 Environmental Protection and Monitoring Measures

Implementation of the environmental protection and monitoring measures outlined below should avoid or minimize additional potential adverse effects to Cultural Resources during implementation of the Proposed Action. These measures are considered integral elements of the project description, and would be fully implemented.

- ▶ Geotextile fabric would be laid out, and small diameter rock placed on top, to prevent soil compaction within known cultural sites.
- ▶ Exclusionary fencing would be erected between known cultural sites and work areas to prohibit vehicular and pedestrian traffic.
- ▶ An archaeologist and Native American monitor would be present during project

activities located within the creek terrace and banks.

► In the event that previously undocumented cultural resources are discovered during construction activities, procedures established in 36 CFR 800.13 and the VAFB Integrated Cultural Resources Management Plan would be followed.

4.3.3 No-Action Alternative

Under the No-Action Alternative, the proposed creek restoration would not occur, and there would be no adverse effects to cultural resources.

4.4 Earth Resources

Factors considered during evaluation of the environmental consequences of the Proposed Action and the No-Action Alternative on earth resources include seismicity, structural damage, tsunamis, surface fault ruptures, and liquefaction.

4.4.1 Proposed Action

Based on a review of the documentation available relative to the geological characteristics and seismic activity of the region, no impacts on geology and soils are anticipated from the Proposed Action.

Implementation of the Proposed Action would require the removal of vegetation and disturbance of soil during excavation. These activities typically loosen the soil and tend to promote erosion during periods of wind or rainfall. Because soils in the area are subject to high wind erosion, appropriate sediment and soil control techniques would be used to minimize soil loss. Soil erosion would be prevented through the restoration of vegetation types during project implementation. With these measures, impacts should be less than significant. Restoration activities would provide long-term beneficial effects by increasing slope stability and decreasing the potential for erosion of the creek bed and banks.

4.4.2 Environmental Protection and Monitoring Measures

Implementation of the environmental protection and monitoring measures outlined below should avoid or minimize potential adverse effects to Earth Resources during implementation of the Proposed Action. These measures are considered integral elements of the project description, and would be fully implemented.

► A SWPPP and BMPs would be prepared and implemented to minimize storm water runoff and erosion as part of the NPDES Construction General Permit.

4.4.3 No-Action Alternative

Under the No-Action Alternative, the proposed restoration of San Antonio Creek on VAFB would not occur. Thus, earth resources would not be affected by project activities. No long-term grade control or bank stabilization would occur, which would allow further erosion of the creek bed and banks.

4.5 Hazardous Materials and Waste Management

Potential impacts as a result of hazardous materials and waste are evaluated using federal, state, and local regulatory requirements, contract specifications, and Base operating constraints, as outlined in Chapter 3, Section 3.5. Hazardous materials management requirements are found in federal and state EPA and OSHA regulations, contract specifications and the VAFB *Hazardous Material Management Plan*, 30 SWP 32-7086. Hazardous waste management requirements are found in federal, state, and local regulations, contract specifications and the VAFB *Hazardous Waste Management Plan*, 30 SWP 32-7043A. Non-compliance with applicable regulatory requirements, human exposure to hazardous materials and wastes, or environmental release above permitted limits, would be considered adverse impacts.

4.5.1 Proposed Action

Compliance with all applicable federal, state and local regulations, rules and requirements, and applicable VAFB plans, would govern all actions associated with implementing the Proposed Action, and would minimize the potential for adverse effects. Hazardous materials and waste management regulations required by federal, state, and local laws and regulations, and procedures outlined in the VAFB *Hazardous Material Management Plan*, 30 SWP 32-7086, and VAFB *Hazardous Waste Management Plan*, 30 SWP 32-7043A, would be followed. Implementing the Proposed Action would require the use of hazardous materials. As described in Chapter 3, Section 3.5, these hazardous materials would be the same types as currently used and managed on VAFB. Because the Proposed Action would last only 7 to 10 weeks, and a small number of workers would be working at any one time (approximately 30-40 personnel), there would not be a significant increase in the amounts of hazardous materials present on VAFB. Thus no significant adverse impacts are anticipated.

Potential adverse effects could result from accidental releases of POLs from vehicle and equipment leaks. All hazardous wastes would be properly managed and disposed of in accordance with applicable federal, state, and local hazardous waste regulations, and the VAFB *Hazardous Waste Management Plan*, 30 SWP 32-7043A. All hazardous wastes would be managed during release response and clean-up.

4.5.2 Environmental Protection and Monitoring Measures

Implementation of the environmental protection and monitoring measures outlined below should avoid or minimize potential adverse effects to Hazardous Materials and Waste Management during implementation of the Proposed Action. These measures are considered integral elements of the project description, and would be fully implemented.

Strict compliance with all applicable federal and state statutes and regulations, as well as local support plans and instructions including 30 SWP 32-7086, *Hazardous Materials Management Plan*, and 30 SWP 32-7043A, *Hazardous Waste Management Plan*, would avert the potential for adverse impacts to the environment as a result of potential generation of hazardous materials and waste during implementation of the Proposed Action.

Implementing the measures presented below should further minimize the potential for adverse impacts from hazardous materials or waste.

- ▶ All hazardous materials required to operate and maintain construction equipment would be properly identified and used in accordance with manufacturer's specifications to avoid accidental exposure or release.
- ▶ Standard procedures would be used to ensure that all equipment is maintained properly and free of leaks during operation, and all necessary repairs are carried out with proper spill containment. A Spill Prevention Plan would be submitted for 30 CES/CEV approval.
- ▶ Hazardous materials would be properly stored and managed in secured areas located outside the riparian corridor.
- ▶ Hazardous materials would be procured through or approved for use by the VAFB HazMart. Monthly usage of hazardous materials would be reported to the HazMart to meet legal reporting requirements.
- ▶ Chemical stockpile spill containment, if necessary, would be accomplished to minimize or preclude hazardous releases.
- ▶ All equipment and holding tanks would be staged, repaired, and maintained at least 500 ft outside the riparian corridor of San Antonio Creek. Fueling and addition of oil/fluids to equipment would be done in pre-designated, controlled surfaces to minimize risks from accidental spillage or release. Spill containment material would be placed around the equipment before fuels, or other

hazardous substances such as oil or brake fluid, are brought in.

- ▶ Equipment operating from the creek banks would be restricted to temporary access roads whenever possible, and the time it is operated outside of these areas would be minimized to the greatest extent feasible. Equipment operating within the creek bed would be placed on protective mats to prevent contamination of the creek bed.

- ▶ If refueling or repair of equipment within the creek bed or riparian corridor is required, safety measures such as the use of temporary catch pans or basins to contain accidental overflow would be implemented. A creek bed refueling spill prevention and containment plan would be prepared and submitted to the 30 CES/CEV for approval.

- ▶ If any equipment repairs are necessary within the creek bed or the riparian corridor, repair would not begin without implementation of a spill prevention and containment plan, and the presence of a qualified biological monitor on the project site.

- ▶ All excess materials excavated would be removed from the creek bed and transported to a designated waste or fill site.

4.5.3 No-Action Alternative

Under the No-Action Alternative, the restoration of San Antonio Creek on VAFB would not be implemented and, therefore, there would be no change in the management or levels of hazardous materials and waste.

4.6 Human Health and Safety

4.6.1 Proposed Action

Compliance with OSHA regulations, and other recognized standards and applicable Air Force regulations or instructions, would be implemented. A health and safety plan would be developed and a formally trained individual would be appointed to act as safety officer. The appointed individual would be the point of contact on all problems involving job site

safety. During performance of work, all provisions and procedures prescribed for the control and safety of personnel and visitors to the job site would be implemented. Therefore, human health and safety would not be adversely impacted by general project-related hazards.

With the implementation of the Environmental Protection and Monitoring Measures outlined in Section 4.6.2, potential health risks to project personnel and the public should be minimal, if any.

Long-term stabilization of the south creek bank would provide a beneficial effect to public safety because it would reduce the potential for San Antonio Road West to be undermined and to fail structurally during heavy flow periods within San Antonio Creek.

Other Potential Hazards

Under the Proposed Action, potential physical hazards typical of any outdoor environment, including holes or ditches, uneven terrain, sharp or protruding objects, slippery soils or mud, and biological hazards including vegetation (i.e. poison oak and stinging nettle), animals (i.e. insects, spiders, and snakes), and disease vectors (i.e. ticks, rodents), exist at and near the proposed restoration areas, and have the potential to adversely impact the health and safety of project personnel. Adherence to federal OSHA regulations should minimize the exposure of workers to these hazards.

Unexploded Ordnance

Special precautions need to be taken in certain areas of VAFB that were used as practice ranges for artillery firing, referred to as areas of potential UXO. Coordination with the EOD Flight prior to implementing the Proposed Action should ensure no adverse effects on human health and safety occur.

Noise

According to regulations of the federal OSHA, employees should not be subjected to sound exceeding a L_{eq1H} of 90 dB for an 8-hour period. This sound level increases by 5 dB with each halving of time (e.g., 4-hour period

at 95 dB). Exposure up to a L_{eq1H} of 115 dB is permitted for a maximum of only 15 minutes during an 8-hour workday and no exposure above 115 dB is permitted. For this analysis, OSHA standards are used as the “not to exceed” criteria as they are the most appropriate standards available.

The Proposed Action would temporarily increase the ambient noise levels within the project area and in neighboring areas during project implementation activities. Relatively continuous noise would be generated by construction equipment. These continuous noise levels are generated from equipment that have source levels (at 1 meter) ranging from approximately 72.7 to 112.7 dB. As a sound source gets further away, the sound level decreases. This is called the attenuation rate. The rates are highly dependent on the terrain over which the sound is passing and the characteristics of the medium in which it is propagating. The rate used in these estimates was a decrease in level of 4.5 dB per doubling of distance. This average rate has been shown to be an accurate estimate from field data on grassy surfaces (Harris 1998). At 50 m these levels range from 47.3 to 87.3 dB. Adverse effects as a result of noise are expected to be minimal and less than significant.

4.6.2 Environmental Protection and Monitoring Measures

Implementation of the environmental protection and monitoring measures outlined below should avoid or minimize potential adverse effects to Human Health and Safety during implementation of the Proposed Action. These measures are considered integral elements of the project description, and would be fully implemented.

- ▶ To provide for the health and safety of workers and visitors who may be exposed to the operations of the Proposed Action, federal OSHA and AFOSH requirements would be implemented during the entire project duration.

- ▶ A Health and Safety Plan would be developed and implemented. Additionally,

coordination with the EOD Flight would occur prior to implementing the Proposed Action to ensure no adverse effects on human health and safety would occur from unexploded ordnance issues.

- ▶ To minimize the potential adverse impacts from biological hazards (e.g., snakes and poison oak) and physical hazards (e.g., rocky and slippery surfaces), awareness training would be incorporated into the worker health and safety protocol.

4.6.3 No-Action Alternative

Under the No-Action Alternative, the proposed habitat restoration would not be implemented and, therefore, there would be no impacts to worker safety. However, the creek banks would continue to erode, decreasing the stability and integrity of San Antonio Road West. This could cause a significant public safety hazard for commuters traveling along San Antonio Road West.

4.7 Land Use and Aesthetics

Factors considered in the evaluation of the environmental consequences of implementing the Proposed Action and No-Action Alternative for land use and aesthetics include:

- ▶ Public accessibility to recreational areas in the vicinity of the proposed project.
- ▶ The potential for a decrease in available agricultural lands near the project area.

4.7.1 Proposed Action

During project activities temporary access roads and staging areas would be constructed within agricultural fields located throughout the restoration area. When construction is complete, these areas would be returned to their original condition. A temporary decrease in productivity would occur during project implementation; however, the Proposed Action would not result in a long-term conversion of prime

agricultural land or cause a decrease in the utilization of land.

Access to recreational areas in the vicinity of the proposed project would not be restricted during the construction period. Throughout the project duration, traffic on San Antonio Road West would be restricted to one lane. However, traffic restrictions are not expected to interfere with public access to facilities on VAFB or recreational areas, and only minor delays are anticipated as a result of roadway restrictions.

A small amount of open space would be used to construct grade control and bank stabilization structures. However, because these areas would be revegetated, there would be no long-term net loss of open space area.

4.7.2 Environmental Protection and Monitoring Measures

Implementation of the environmental protection and monitoring measures outlined below should avoid or minimize potential adverse effects to Land Use and Aesthetics during implementation of the Proposed Action. These measures are considered integral elements of the project description, and would be fully implemented.

Because of the potential for temporary adverse downstream effects that may occur during project implementation within the California Coastal Zone, the Air Force will coordinate the Proposed Action with the California Coastal Commission prior to implementation.

4.7.3 No-Action Alternative

Under this alternative, restoration of San Antonio Creek on VAFB would not occur. The integrity of San Antonio Road West could be compromised as stream flows continue to erode the creek banks. Further erosion of the creek banks could result in the closure of San Antonio Road West, prohibiting access to north Base facilities. The loss of San Antonio Road West would have a significant adverse effect to land use on VAFB.

4.8 Transportation

Impacts to the transportation system at VAFB would be considered significant if:

- ▶ A primary roadway could no longer service the traffic demands of that roadway;
- ▶ The project access to a primary or local road would require a driveway that would create an unsafe situation or a new traffic signal or major revisions to an existing traffic signal; or
- ▶ The project adds traffic to a roadway that has limiting design features or receives use that would be incompatible with substantial increases in traffic, which would become potential safety problems with the addition of project or cumulative traffic. Limiting design features include, but are not limited to narrow width, roadside ditches, sharp curves, poor sight distance, and inadequate pavement structure. Some examples of a roadway receiving incompatible use are large number of heavy trucks on rural roads used by farm equipment, livestock, horseback riding, or on residential roads with heavy pedestrian or recreational use.

4.8.1 Proposed Action

Given the low ADT volumes and good LOS currently experienced on the roadways that would be affected by project activities on VAFB, the slight increase in daily truck traffic anticipated under the Proposed Action would not result in adverse effects to their capacity. All VAFB roadway sections should continue to operate at an LOS in the range of A to B with project-added traffic.

Numerous truck trips on roads and highways in the vicinity of the proposed restoration area would be required to transport large quantities of material to the project site. These activities would be coordinated with Caltrans to ensure authorization of truck travel routes. A traffic control plan would be developed in coordination with the California Highway Patrol (CHP), and implemented to adequately facilitate the movement of traffic, that would

cover all conditions to be encountered during construction.

While the current condition of the pavement on all of the affected roadways on VAFB is fair to good, added truck traffic could cause faster than estimated deterioration of the pavement surface and require additional maintenance. Roadways disturbed by construction activities or construction vehicles would be properly restored to ensure long-term protection of the road surface.

No significant impacts are anticipated from the Proposed Action. Implementing the measures described in Section 4.8.2 should minimize the potential for adverse effects on transportation.

4.8.2 Environmental Protection and Monitoring Measures

Implementation of the environmental protection and monitoring measures outlined below should avoid or minimize potential adverse effects to Transportation during implementation of the Proposed Action. These measures are considered integral elements of the project description, and would be fully implemented.

- ▶ Truck trips would be scheduled during non-peak traffic hours.
- ▶ VAFB would coordinate with Caltrans and the CHP for the transportation of rock from quarries to the project site, and for accessing the project site through Hwy 1.
- ▶ Warning signs, cones, and flaggers would be provided to warn roadway users of lane closures on San Antonio Road West, of truck crossings on Hwy 1, and to control traffic flow.
- ▶ Both lanes of San Antonio Road West would remain open at all times during non-construction periods.
- ▶ Construction equipment would not be parked along the shoulder of San Antonio Road West during non-construction periods.
- ▶ Project employees would be encouraged to carpool and eat lunch on-site.

4.8.3 No-Action Alternative

Under the No-Action Alternative, no restoration activities would occur. Therefore, there would be no effect on existing transportation. However, the banks of San Antonio Creek would continue to erode, decreasing the stability and integrity of San Antonio Road West. If the road were to collapse, traffic would be forcibly diverted to other roads, and result in an interruption of mission essential transportation. In addition, such a situation would result in a fast track reconstruction project involving intensive construction activities. Such an action could affect local traffic conditions and cause adverse effects on local transportation routes.

4.9 Water Resources

Adverse impacts to water resources would occur if the Proposed Action:

- ▶ Caused substantial flooding or erosion;
- ▶ Adversely affected surface water quality to creeks or rivers; or
- ▶ Adversely affected groundwater or water quality to localized water resources.

4.9.1 Proposed Action

The Proposed Action would require coverage under the NPDES Construction General Permit because the total disturbed area would be greater than 1 acre. A SWPPP would be developed and implemented to maintain compliance with the NPDES Construction General Permit. During site preparation and construction activities, storm water/erosion BMPs would be implemented during and after any clearing, excavation, and grading. Long-term BMPs would be put in place to address storm water erosion after project completion.

A *Notice of Intent* would be submitted to the SWRCB. A *Notice of Termination* would be submitted to the Central Coast RWQCB to ensure all permit termination requirements are met. The *Notice of Intent* and *Notice of Termination* would be coordinated with the

30 CES/CEV and signed by the 30th Civil Engineer Squadron Commander (30 CES/CC) or Deputy Commander (30 CES/CD) prior to submittal.

A CWA Section 401 Water Quality Certification from the Central Coast RWQCB and CWA Section 404 Permit from the USACE would also be required under the Proposed Action because direct impacts to water bodies or wetlands would occur.

All permit conditions would be implemented, including SWPPP BMPs and inspections, and the VAFB *Discharge to Grade Program* to minimize the potential for adverse impacts to local water resources. With the implementation of these procedures and requirements, adverse effects to water resources would be less than significant, as described below.

4.9.1.1 Surface Water

Construction activities would include the use of hazardous materials that could result in an adverse impact if not properly controlled and managed. The use of POLs during construction poses the potential for releasing pollutants and adversely affecting water resources. Proper management of materials and wastes during construction would reduce or eliminate the potential for contaminated runoff. There would be no discharge of groundwater to surface water. The VAFB *Discharge to Grade Program* would manage wastewater discharges that may occur during project activities, including accumulated storm water. As required by the NPDES Construction General Permit, BMPs would be implemented to properly manage materials, and reduce or eliminate project-associated runoff to further reduce the potential for adverse effects, especially during the rainy season.

Because equipment may require refueling within the creek bed, a creek bed refueling plan would be included in the Spill Prevention and Containment Plan, including appropriate safety precautions and personnel training. At a minimum, the plan should include measures that would prevent the contamination of the

substrate in the event of an accidental spill and an emergency clean-up plan in the event of an accidental spill.

The containment of the active channels in culverts within the construction zone should minimize the exposure of the stream water to any project-related contaminants.

With these measures in place, adverse effects to surface water should be less than significant. Potential project-related effects to sediment are addressed in Section 4.9.1.2 below.

4.9.1.2 Sediment

The Proposed Action may result in an increase in sediment load during project implementation due to excavation of the creek bed and banks, placement of fill material, and removal of vegetation. Increases in sediment load in the vicinity of the proposed project area would be minimized by containing the active river channels within temporary culverts, and by implementing erosion and sediment control BMPs (i.e., silt fencing), and measures described in the project's SWPPP. In the event construction activities continue beyond October 15, disturbed soil areas would be stabilized at least 48-hours in advance of a predicted rain event. After construction, any disturbed/bare ground areas, except established roads and the active creek channel, would be revegetated with an appropriate plant and seed mix. Restoration of vegetation types during project implementation should minimize potential sediment loading post-construction through soil stabilization. In addition, all NPDES Construction General Permit requirements would be implemented until the Central Coast RWQCB officially terminates the permit coverage. No significant adverse impacts would occur from the Proposed Action. The measures detailed in Section 4.9.2 should minimize or prevent the potential for adverse effects.

The existing creek channel restricts stream flows, which increases sediment deposition over a small area. Excavation of floodplain terraces within the proposed restoration area

would allow stream waters to flow over larger areas, and sediment would accumulate less rapidly. Sediment loads are expected to decrease within the section of San Antonio Creek proposed for restoration as the area of deposition increases.

A portion of the sediment delivered to the San Antonio Creek riparian corridor comes from continued erosion of the channel bed and banks. The installation of grade control and bank stabilization structures would decrease the rate of erosion of the creek bed and banks, resulting in a reduction in the sediment load of the creek through the restoration area.

4.9.1.3 Floodplain

The proposed restoration area is located within the San Antonio Creek floodplain. Creek restoration activities would necessitate working within this floodplain. Chapter 2 of this EA supports the finding that there is no practicable alternative to construction within the floodplain or wetland areas. The floodplain limits in the vicinity of restoration area would not be altered by activities associated with the Proposed Action. The 100-year floodplain limit and duration of flooding within the project area would remain approximately the same as those currently present.

4.9.1.4 Hydraulics

The active river channel would be temporarily contained in culverts, allowing for unimpeded flow through the restoration area. This would allow the creek to maintain its seasonal hydraulic capacity and minimize the potential for adverse impacts to water resources during project implementation.

Construction of rock-riffle grade controls, low-flow channels, and floodplain terraces would alter the velocity, width, and depth of San Antonio Creek through the restoration area. The Proposed Action would provide a beneficial effect of increasing flow areas and decreasing velocity. In addition, enhanced hydraulic conditions for the dense willow riparian woodland habitat are anticipated.

4.9.1.5 Groundwater

Groundwater is likely to be encountered during excavation within the creek bed. If dewatering is necessary, approval would be obtained from the 30 CES/CEV Water Resources Program Manager. The water would be filtered and discharged into a vegetated area outside the creekbed and downstream of the project area. Grade control structures would prevent headcuts present in the creek bottom from migrating upstream, reducing potential lowering of the groundwater table through the restoration area.

No significant impacts would occur from the Proposed Action. The measures detailed in Section 4.9.2 should minimize or prevent the potential for adverse effects to groundwater.

4.9.2 Environmental Protection and Monitoring Measures

Implementation of the environmental protection and monitoring measures outlined below should avoid or minimize potential adverse effects to Water Resources during implementation of the Proposed Action. These measures are considered integral elements of the project description, and would be fully implemented.

Compliance with NPDES Construction General Permit and CWA Section 401 Water Quality Certification conditions should minimize potential adverse impacts to water resources. A SWPPP approved by 30 CES/CEV would be developed and implemented prior to initiation of any activities under the Proposed Action. *Discharge to Grade Program* procedures should minimize the potential for adverse impacts to local water resources.

In addition, implementation of the measures described below should further reduce the potential for adverse effects to water resources:

- Construction activities within the creek would occur between approximately August 25 and October 15. In the event construction

activities continue beyond October 15, disturbed soil areas would be stabilized, and construction vehicles and potential pollutants removed from the project area 48-hours in advance of a predicted rain event.

- ▶ A Certified Erosion and Sediment Control Specialist, or other qualified professional experienced in erosion and sediment control, would be onsite during construction activities.

- ▶ BMPs, including erosion and sediment control, proper spill prevention practices for all stored liquids and construction vehicles, and permanent erosion control, would be implemented to prevent sediment or chemicals from entering creek and storm waters.

- ▶ Temporary creek diversions would be constructed of materials free of pollutants such as soil, silt, sand, clay, grease or oil. Diversions would be adequately designed to accommodate fluctuations in water flow volume, and would provide for velocity dissipation at the outfall.

- ▶ Approval would be obtained from the 30 CES/CEV Compliance Office, Water Resources Manager, prior to any release to grade of any water (*Discharge to Grade Program*).

- ▶ If dewatering is necessary, the water would be discharged to an upland vegetated location downstream of the project area in a manner that would not cause erosion. Water pumps used to dewater excavated areas would incorporate filters.

- ▶ Appropriate sediment control (e.g., fiber rolls, silt fencing) would be erected in all needed areas to prevent sediment loading.

- ▶ All disturbed areas resulting from construction, except established roads and the active creek channel, would be revegetated during implementation of the Proposed Action.

- ▶ During construction activities, areas with exposed disturbed soil would be stabilized per the NPDES Construction General Permit (refer to Section A, item 7, page 15 of the Permit).

- ▶ Acceptable water quality parameters (e.g., pH, temperature, DO, turbidity), determined by the Central Coast RWQCB Basin Plan, would be monitored during the construction period no more than 400 ft downstream of the project area.

4.9.3 No-Action Alternative

Under the No-Action Alternative, the proposed creek restoration would not occur and, no impacts to water resources would occur as a result of project activities. However, further incision of the creek bed and banks during periods of high stream flows would occur, increasing the sediment load and turbidity of the creek. The headcuts present in the creek channel would continue to migrate upstream, resulting in the lowering of the groundwater table.

4.10 Cumulative Impacts

Adverse cumulative impacts (hereinafter referred to as “cumulative impacts”) result from the incremental effect of an action when added to other past, present, and reasonably foreseeable future actions, regardless of the agency that undertakes these other actions. Cumulative impacts can result from actions whose adverse impacts are individually minor or negligible, yet, over a period of time, are collectively significant.

Emergency repairs to three sites within San Antonio Creek and a tributary were performed in late February and early March of 1998 to protect threatened facilities. Additional long-term erosion repairs are proposed at the Bank Stabilization Site 2 and Lee Road Utility Bridge Site. The combination of these actions would result in greater impacts than would have occurred with a single action within this section of San Antonio Creek. However, it is anticipated that the net effects of these actions would be beneficial, given the biological creek restoration that would be implemented as part of the Proposed Action.

A partial list of projects for which NEPA analysis was completed within the past 5

years, including cumulative impacts analysis, is detailed in Table 4-2. Of these, projects that are currently in progress or will be implemented in the future at VAFB include: demolition and abandonment of Atlas and Titan facilities, installation of fiber optic lines associated with the VTRS Supplement, emergency repair of the 13th Street Bridge, and several projects to occur within the main and south Base cantonments under the Military Construction (MILCON) and non-appropriated funds programs. Future projects for which NEPA analysis is currently underway include: western snowy plover habitat restoration, safety and security upgrades of entry control facilities, and Western Range instrumentation modernization.

Air quality impacts were considered in conjunction with on-going and future projects planned at VAFB. The cumulative emissions from projects included under the Proposed Action and past, present, and future projects would not exceed the significance thresholds of 548 lbs/day or 100 tons/year because any project that would cause an exceedance would be postponed until the following calendar year. Therefore, no significant cumulative impacts to the region's air quality would occur.

Adverse effects to biological and cultural resources should be minimized with the implementation of measures described in Sections 4.2.2 and 4.3.2 of this EA, identified in EAs completed for other projects, to be incorporated in EAs currently under development for future projects, and identified and established by VAFB for operations and maintenance (O&M) projects. With these measures in place, no significant cumulative impacts are anticipated.

No significant impacts to earth resources are anticipated from either the Proposed Action or any of the other projects currently being implemented on VAFB. Environmental assessments under development for future projects would identify any potential adverse effects to earth resources and describe measures to avoid or minimize these adverse effects. No cumulative impacts are anticipated.

When considered with other past, present, and future projects on VAFB, the Proposed Action was found to have no cumulative impacts on Environmental Justice, as activities covered under this EA would occur within VAFB boundaries and not affect minority communities.

Table 4-2. Partial list of projects for which NEPA analysis has been completed in the previous 5 years.

Name of Project	NEPA Analysis Timeframe	Project Timeframe
13th Street Bridge Emergency Repairs	EA completed in 2003.	Project completed in 2004.
VTRS Fiber Optic Cable Installation	EA completed in 2004.	Project mostly completed in 2007. See VTRS Supplement below.
Demolition and Abandonment of Atlas and Titan Facilities	EA completed in 2005.	Project on-going.
Combat Information Transport System Upgrade	EA completed in 2006.	Project completed in 2007.
VTRS Supplement	EA completed in 2007.	Project to be implemented in Spring 2008.
New 13th Street Bridge	EA completed in 2007.	Project implementation in flux, currently no earlier than 2011.
2007 General Plan for Main and South Base Cantonments	EA completed in 2008.	Projects to be implemented between 2009 and 2014.

Hazardous materials/wastes encountered or generated during the Proposed Action would be managed in strict compliance with all applicable statutes and regulations, as well as local support plans and instructions including 30 SWP 32-7086, *Hazardous Materials Management Plan*, and the 30 SWP 32-7043A, *Hazardous Waste Management Plan*, to avert the potential for adverse impacts.

Implementing the measures described in Section 4.5.2 of this EA, identified in the EAs completed for other projects, to be incorporated in EAs currently under development for future projects, and identified and established by VAFB for O&M projects, should avoid or minimize any potential adverse effects. No significant cumulative impacts are anticipated.

Given the requirement to comply with federal and state OSHA, and all other applicable federal, state, and local regulations, no adverse impacts and therefore no cumulative impacts to Human Health and Safety are anticipated.

No cumulative impacts are anticipated in regards to land use as the Proposed Action, would not change land use on VAFB, result in the conversion of prime agricultural land to other uses, or result in adverse effects.

No adverse impacts to socioeconomics and therefore no cumulative impacts are expected under the Proposed Action, given that small numbers of personnel utilized for creek restoration activities and the short-term nature of the activities.

Minimal levels of solid waste are anticipated to occur under the implementation of the Proposed Action. All solid waste would be properly disposed of, at either at the VAFB Landfill or off VAFB property, as appropriate. With these measures in place no significant cumulative effects are anticipated.

Given the good LOS ratings for primary roadways at VAFB, and with the

implementation of measures described in Section 4.8.2 of this EA, identified in the EAs completed for other projects, to be incorporated in EAs currently under development for future projects, and identified and established by VAFB for O&M projects, activities covered under the Proposed Action would be unlikely to have significant impacts to the transportation system on VAFB and in the region. No cumulative impacts are anticipated.

All activities under the Proposed Action would be subject to all requirements contained in the NPDES Construction General Permit. Implementation of measures described in Section 4.9.2 of this EA, identified in the EAs completed for other projects, to be incorporated in EAs currently under development for future projects, and identified and established by VAFB for O&M projects, should avoid or minimize any potential adverse effects. No significant cumulative impacts to water resources are anticipated.

To ensure that no significant cumulative impacts result from VAFB projects occurring concurrently or non-currently, VAFB includes environmental contract specifications and mitigation/protective measures as necessary in all projects. Actions are taken during the planning process to ensure adverse impacts are minimized or avoided all together as projects are reviewed under NEPA. Prior projects are also considered to ensure no levels of acceptable impacts are exceeded.

With these practices in place, and given that all VAFB projects are designed and implemented to be in full compliance with applicable statutes and regulations, and environmental protection measures are developed in coordination with appropriate regulatory agencies, the activities included under the Proposed Action, in conjunction with other foreseeable projects at VAFB, would not result in significant cumulative impacts.

[This page intentionally left blank.]

Chapter 5. Persons and Agencies Contacted

Bea Kephart, Chief, Environmental Flight, 30 CES/CEV, VAFB
Brian Doeing, Senior Associate Engineer, HDR Inc.
Chris Ryan, Chief, Cultural Resources, 30 CES/CEV, VAFB
Dave Derrick, Research Hydraulic Engineer, USACE Waterways Experiment Station
Dave Savinsky, Air Quality, 30 CES/CEV, VAFB
Dina Ryan, Environmental Planner, 30 CES/CEV, VAFB
Jamie Uyehara, Wildlife Biologist, 30 CES/CEV, VAFB
John McCullah, Watershed Geologist, Salix Applied Earthcare
Jordan Hampton, Transportation Engineer, 30 CES/CECC, VAFB
Luanne Lum, Botanist, 30 CES/CEV, VAFB
Mike Bird, Project Manager, 30 CES/CECC, VAFB
Rhys Evans, Wildlife Biologist, 30 CES/CEV, VAFB
Tara Wiskowski, Water Quality, 30 CES/CEV, VAFB
Tim Belton, Rangeland Ecologist, 30 CES/CEV, VAFB
Tom Cugini, Chief, Civil Engineering and Contracts, 30 CES/CECC, VAFB

[This page intentionally left blank.]

Chapter 6. List of Preparers

Abela, Alice, Wildlife Biologist, ManTech SRS Technologies, Inc.

B.S. 2003 Biology, California Polytechnic State University, San Luis Obispo

Years of Experience: 5

Ball, Morgan, Wildlife Biologist, ManTech SRS Technologies, Inc.

B.S. 2001 Biology, Evolution/Ecology, University of California, Santa Barbara

Years of Experience: 10

Lebow, Clayton, Vice President/Senior Archaeologist, Applied EarthWorks, Inc.

B.S. 1977, Forest Engineering, Oregon State University, Corvallis

M.A. 1982, Archaeology, Cultural Anthropology & Geography, Oregon State University, Corvallis

Years of Experience: 29

Fillmore, Leslie. Environmental Engineer, ManTech SRS Technologies, Inc.

B.S. 1994. Biology, University of North Carolina at Chapel Hill

Years of Experience: 12

Kaisersatt, Samantha, Biologist, ManTech SRS Technologies, Inc.

B.S. 2000 Ecology & Systematic Biology, California Polytechnic State University, San Luis Obispo

Years of Experience: 8

Nieto, M. Paloma, Conservation Program Manager/Senior Research Biologist, ManTech SRS Technologies, Inc.

B.S. 1997 Ecology & Wildlife Biology, California Polytechnic State University, San Luis Obispo

M.S. 1999 Biological Sciences, California Polytechnic State University, San Luis Obispo

Years of Experience: 13

[This page intentionally left blank.]

Chapter 7. Distribution List

California Coastal Commission, Federal Consistency Review, San Francisco, CA
California Native Plant Society, Los Osos, CA
California Regional Water Quality Control Board, Central Coast Region, San Luis Obispo, CA
Environmental Defense Center, Santa Barbara, CA
La Purisima Audubon Society, Lompoc, CA
Lompoc Public Library, Lompoc, CA
Natural Resources Conservation Service, Santa Maria, CA
Santa Barbara County Air Pollution Control District, Project Review, Santa Barbara, CA
Santa Barbara Museum of Natural History, Santa Barbara, CA
Santa Ynez Chumash Indian Reservation, Tribal Elders Council, Santa Ynez, CA
Santa Barbara Public Library, Santa Barbara, CA
Santa Maria Public Library, Santa Maria, CA
University of California, Library, Santa Barbara, CA
University of California, Museum of Systematics & Ecology, Santa Barbara, CA
U.S. Fish and Wildlife Service, Ventura Field Office, Ventura, CA
VAFB Library, VAFB, CA

[This page intentionally left blank.]

Chapter 8. Bibliography

- Alterman, I.B., R.B. McMullen, L.S. Cluff, and D.B. Slemmons (eds). 1994. Seismotectonics of Central California Coast Ranges. Geological Society of America Special Paper 292.
- Arnold, R.A. 1978. Status of six endangered California butterflies, 1977. California Dept. of Fish & Game, Nongame Wildlife Investigations #-1-1, Study V, Job 2.20. Sacramento, CA. 95 pp.
- Arnold, R.A. 1981. A review of endangered species legislation in the USA and preliminary research on 6 endangered California butterflies. Beih. Veroff. Naturschutz. Landschaftspflege Bad.-Wurt. 21: 79-96.
- Arnold, R.A. 1983. Ecological studies of six endangered butterflies (Lepidoptera: Lycaenidae): island biogeography, patch dynamics, and the design of habitat preserves. Univ. of Calif. Publ. in Entomology. 99:1-161.
- Aspen Environmental Group and Simons, Li and Associates. 1998. Alternative Analysis Report, San Antonio Creek Crossing Alternatives.
- Baskin, J.N., and M.A. Bell. 1976. Unarmored Threespine Stickleback Survey and Report. Report for the U.S. Department of Agriculture, Forest Service. 47 pp.
- Berry, S.H. 1991. A-6 Power Line Surface Survey, Vandenberg Air Force Base, Santa Barbara County, California. On file, California Historical Resources Information System, Central Coast Information Center, University of California, Santa Barbara.
- Berry, B.F., R.C. Payne, and A.L. Harris. 1991. Noise levels of USAF aircraft in Exercise "Luce Belle". National Physics Laboratory Report RSA (EXT) 16. 22pp.
- Berry, S.H. 1994. San Antonio 14-Inch Water Line Archaeological Survey and Testing Report. 30 CES, Environmental Flight, Vandenberg Air Force Base, California. Prepared for the California Office of Historic Preservation.
- Bowser, B., and T. Morgan. 1986. Archaeological and Geomorphological Investigations: SBA-1010 Vandenberg Air Force Base, Santa Barbara County, California. URS Corporation, Santa Barbara, California. Prepared for the Public Works Department, Santa Barbara County, California.
- CARB. 2007. EMFAC2007 (Version 2.3) BURDEN Model.
- Carbone, L.A., and R.D. Mason. 1998 Phase I, II, and III Archaeological Surveys for Cultural Resources Inventory, Vandenberg Air Force Base, Santa Barbara County, California. Science Applications International Corporation and Chambers Group, Inc., Santa Barbara, California. Submitted to USDI National Park Service, Western Region Interagency Archeological Services Branch, San Francisco.
- CDFG. 1999. Special Status Plants, Animals and Natural Communities of Santa Barbara County. California Natural Diversity Data Base.
- CDFG. 2001. Special Plants and Animals: Casmalia USGS Quadrangle. California Natural Diversity Database.

- CDFG. 2008a. Special Animals. Department of Fish and Game Wildlife and Habitat Analysis Branch. California Natural Diversity Database. Retrieved from the World Wide Web: <http://www.dfg.ca.gov/biogeodata/cnddb/pdfs/SPAnimals.pdf>.
- CDFG. 2008b. Special Vascular Plants, Bryophytes, and Lichens List. Department of Fish and Game Wildlife and Habitat Analysis Branch. California Natural Diversity Database. Retrieved from the World Wide Web: <http://www.dfg.ca.gov/biogeodata/cnddb/pdfs/SPPlants.pdf>.
- Christopher, S.V. 1996. Reptiles and amphibians of Vandenberg AFB, Santa Barbara County, California. Museum of Systematics and Ecology, Report No. 4, University of California, Santa Barbara, in cooperation with the National Biological Service, San Simeon.
- Christopher, S.V. 2002. Sensitive Amphibian Inventory at Vandenberg Air Force Base, Santa Barbara County, California. Summary of Preliminary Results and Site Maps. Appendix A Field Survey Data January 1995 through March 2002.
- Clark, M.E. 1997. Archaeological Surveys around Septic Systems at Various Facilities, Vandenberg Air Force Base, Santa Barbara County, California. Tetra Tech, Inc., Santa Barbara, California, and Applied EarthWorks, Inc., Fresno, California. Submitted to 30 CES/CEV, Vandenberg Air Force Base, California, USAF Contract No. F04684-95-C-0045.
- Colten, R.H., C.G. Lebow, C. Denardo, R.L. McKim, D.R. Harro, C.H. Miksicek, and B. Bowser. 1997. Hunter-Gatherer Land Use in the San Antonio Creek Drainage: Archaeological Investigations at CA-SBA-2696. Barry A. Price, general editor. Applied EarthWorks, Inc., Fresno, California. Submitted to Central Coast Water Authority, Buellton, California.
- Coulombe, H.N., and C.R. Mahrtdt. 1976. Ecological Assessment of Vandenberg Air Force Base, California. Vol II: Biological inventory, 1974/75. Prepared for Headquarters Space and Missile Systems Org., Air Force Systems Command, Los Angeles Air Force Station, California.
- Davis, S. 2003. Monitoring for Troubleshoot and Repair of Cable 27. Submitted to 30 CES/CEV, Vandenberg Air Force Base, California.
- Dibblee, T.W. Jr. 1950. Geology of the southwestern Santa Barbara County, California. California Division of Mines Bulletin 150.
- Dibblee. 1989. Geologic Map of the Casmalia and Orcutt Quadrangles, Santa Barbara, California, Scale 1:24000, Dibblee Geological Foundation Map #DF-24.
- Foster, J.M. 1985. Archaeological Investigations: Vandenberg Air Force Base Communication Line #1976, Santa Barbara County, California. Greenwood and Associates, Pacific Palisades, California. Submitted to USDI National Park Service, Interagency Services Division, San Francisco, in partial fulfillment of PX-8000-6-0080.
- Foster, J.M., and R.S. Greenwood. 1985. Archaeological Investigation: Northwest Lompoc/Jesus Maria Project, Union Oil Company of California, Vandenberg Air Force Base. Greenwood and Associates, Pacific Palisades, California. Prepared for Dames & Moore, Santa Barbara, California.
- Fugro. 2006. Geotechnical Report, San Antonio Road West Stabilization, Vandenberg Air Force Base, California.
- Gibson, R.O. 1987a. Results of Archaeological Surface Survey for Proposed Fences at San Antonio Pasture #7 and Santa Lucia Pasture #9 on Vandenberg Air Force Base, California. Robert O. Gibson, Archaeological Consultant, Paso Robles, California. Prepared for the Farm Center, Lompoc, California.

- Gibson, R.O. 1987b. Results of Archaeological Surface Survey for Two Fence Improvement Projects on Vandenberg Air Force Base, California. Robert O. Gibson, Archaeological Consultant, Paso Robles, California. Prepared for Vandenberg Air Force Base Range Management, Santa Barbara County, California.
- Greenwood, R.S. 1984. Letter Report on an Archaeological Survey of a Union Oil Pipeline Corridor as Requested by Dames and Moore of Santa Barbara. Greenwood and Associates, Pacific Palisades, California.
- Greenwood, R.S., and J.M. Foster. 1981. Range Improvement Project, Vandenberg Air Force Base, Santa Barbara County, California. 2 vols. Greenwood and Associates, Pacific Palisades, California. Prepared for Vandenberg Air Force Base, Civil Engineering Squadron, Environmental Planning Branch, Santa Barbara County, California. Submitted to USDI National Park Service, Western Region Interagency Archeological Services Branch, San Francisco, in partial fulfillment of Purchase Order PX8000-1-0421.
- Harro, D.R., and C.G. Lebow. 2002. Emergency Archaeological Testing for Utility Pole Replacement, Vandenberg Air Force Base, Santa Barbara County, California. Applied EarthWorks, Inc., Lompoc, California. Prepared for Pacific Gas and Electric Company, San Francisco. Submitted to Cultural Resources Management Office, 30th Civil Engineer Squadron, Environmental Flight, Vandenberg Air Force Base, California.
- Harro, D.R., and C. Ryan. 1997. Archaeological Boundary and National Register Eligibility Testing for the Septic Systems Repair Project, Vandenberg Air Force Base, California. Applied EarthWorks, Inc., Fresno, California, for Tetra Tech, Inc., Santa Barbara, California. Submitted to 30 CES/CEV, Vandenberg Air Force Base, California, USAF Contract No. F04684-95-C-0045.
- Haslouer, L., and D. Kay. 1996. Archaeological Survey Report U.S. Penitentiary's San Antonio Grazing Unit Fence Construction. Submitted to 30 CES/CEVPC, Vandenberg Air Force Base, California.
- HDR. 2006. Slope Stabilization Design Scour Analysis for San Antonio Creek (Sites 1, 2, and 3).
- HDR. 2008. San Antonio Creek Stream Restoration, Basis of Design Report. February 22, 2008.
- Hickman, J.C. (ed.). 1993. The Jepson Manual. Higher Plants of California. University of California Press, Berkeley. 1400pp.
- Higgins Associates. 2001. Vandenberg AFB Cantonment Area Multimodal Circulation Study and Transportation Plan (CTR) (50% draft submittal). November.
- Holland, R.F. 1986. Preliminary Descriptions of the Terrestrial Natural Communities of California. California Department of Fish and Game, Sacramento.
- Holmgren, M.A., and P.W. Collins. 1999. Final report on the distribution and habitat associations of six bird species of special concern at Vandenberg Air Force Base, Santa Barbara County, California. Prepared for Vandenberg Air Force Base, 30CES/CEVPN, Natural Resources, Vandenberg Air Force Base, California. Santa Barbara Museum of Natural History Monographs No. 1, Studies in Biodiversity No. 1. 204 pp.
- Jennings, C.W. 1994. Fault map of California and adjacent areas. California Division of Mines and Geology. California Geological Data Map Series, Map No. 6, Scale 1:750,000.
- Jones & Stokes Associates. 2007. Software User's Guide: URBEMIS2007 for Windows Version 9.2. Emissions Estimation for Land Use Development Projects. November.

- Keil, D.J., and V.L. Holland. 1998. Documented Flora of Vandenberg Air Force Base, Santa Barbara County, California. California Polytechnic State University, San Luis Obispo.
- Kirkish, A.N. 1990. Cultural Resources Survey and Effect Evaluation for the Have Stare Tracking and Imagery Radar System Project, Vandenberg Air Force Base, California. 30 CES/CEVP, Vandenberg Air Force Base, California. Submitted to U.S. Air Force Systems Command, Electronic Systems Division.
- Lebow, C.G. 2000. Cultural Resource Studies in Support of the El Rancho Road Bridge Project, Including an Archaeological Survey of the San Antonio Creek Cutbanks, Vandenberg Air Force Base, Santa Barbara County, California. Applied EarthWorks, Inc., Fresno, California, for Tetra Tech, Inc., Santa Barbara, California. Submitted to 30 CES/CEV, Vandenberg Air Force Base, California, USAF Contract No. F04684-95-C-0045.
- Lebow, C.G., and R.L. McKim. 2001. Archaeological Survey for PG&E Access Road and Transmission Line Repairs on North Vandenberg Air Force Base, Santa Barbara County, California. Applied EarthWorks, Inc., Lompoc, California. Prepared for Pacific Gas and Electric Company, San Francisco. Submitted to Cultural Resources Management Office, 30th Civil Engineer Squadron, Environmental Flight, Vandenberg Air Force Base, California.
- Lebow, C.G., R.L. McKim, D.R. Harro, C.M. Hodges, and A.M. Munns. 2005. Large Game Hunting and Other Paludal Adaptations at Barka Slough: Excavations at CA-SBA-1010, Vandenberg Air Force Base, Santa Barbara County, California. Applied EarthWorks, Inc., Lompoc, California. Submitted to 30 CES/CEVPC, Vandenberg Air Force Base, California.
- Lebow, Clayton G., Christopher Ryan, and Leann Haslouer. 2007. Archaeological Survey Report, San Antonio Creek Stream Restoration Project, Vandenberg Air Force Base, Santa Barbara County, California.
- Lehman, P.E. 1994. The birds of Santa Barbara County, California. Vertebrate Museum, University of California, Santa Barbara. 337 pp.
- Mattoni, R.H.T. 1992. The endangered El Segundo blue butterfly. *Journal of Research Lepidoptera* vol. 29. 277-304 pp.
- Mirro, M.J., and C.G. Lebow. 2003. Archaeological Survey of the Harris Wildfire Burn Area on North Vandenberg Air Force Base in Santa Barbara County, California. Applied EarthWorks, Inc., Lompoc, California. Submitted to 30 CES/CEV, Vandenberg Air Force Base, California, USAF Contract No. T0900DF415.
- MSRS. 2008. Assessment of Wetland Habitats at the San Antonio Creek Restoration Site. Vandenberg AFB, California. April 2008. 120 pp.
- MSRS, R. Arnold, and G. Pratt. 2008. El Segundo Blue Butterfly (*Euphilotes battoides allyni*): Flight Season Surveys. Vandenberg AFB, California. January 2008. 24 pp.
- Muir, K.S. 1964. Geology and Ground Water of San Antonio Creek Valley, Santa Barbara County, California. U.S Geological Survey Water Supply Paper 1664, prepared in cooperation with the Santa Barbara County Water Agency.
- Parreira, H. 2003. San Antonio Road West Drainage Construction. Applied EarthWorks, Inc., Lompoc, California. Submitted to 30 CES/CEVPC, Vandenberg Air Force Base, California.
- Parreira, H. 2004. Indyne Cable 40 Repairs near Building 22300. Applied EarthWorks, Inc., Lompoc, California. Submitted to 30 CES/CEVPC, Vandenberg Air Force Base, California.

- Pratt, G.F., and G.R. Ballmer. 1993. Correlations of diapause intensities of *Euphilotes* spp. and *Philotiella speciosa* (Lepidoptera:Lycaenidae) with host bloom period and elevation. *Ann. Ent. Soc.* 86: 265-272.
- Price, B.A., R.H. Colten, T.W. Canaday, M.Clark Baloian, C. Ryan, T.P. Fulton, M.H. Imwalle, and C.K. Roper. 2006. Final Report of Archaeological Investigations for the Mission Hills and Santa Ynez Extension, Coastal Branch Aqueduct, Phase II, with contributions by Douglas R. Harro, Kurt T. Katsura, and Rebecca L. McKim. Applied EarthWorks, Inc., Fresno, California. Prepared for Central Coast Water Authority, Buellton, California.
- RESCOM Environmental Group Corp. 2004. Historic Resource Report SN60XC206-A/VERIZON BAK 154 Firefighter Road East of Hwy 1, Lompoc, Santa Barbara County, California. On file, California Historical Resources Information System, Central Coast Information Center, University of California, Santa Barbara.
- Reynolds, Smith and Hill, Inc. (Reynolds et al). 1985. Phase I problem identification and records search, Vandenberg Air Force Base, Installation Restoration Program. Jacksonville, Florida.
- Rocky Mountain Bio Products. 2008. Retrieved from the World Wide Web: <http://www.rockymtnbioproducts.com/biosol.htm>.
- Rudolph, J.L. 1983. Archaeological Monitoring of Drilling Site Arkley 19-1. On file, California Historical Resources Information System, Central Coast Information Center, University of California, Santa Barbara.
- Rudolph, J.L. 1988 Phase I Archaeological Survey for Proposed Fence Lines in Santa Lucia Canyon and San Antonio Valley, Vandenberg Air Force Base. URS Corporation, Santa Barbara, California. Submitted to 30th Civil Engineer Squadron, Environmental Flight (30 CES/CEV), Vandenberg Air Force Base, Santa Barbara County, California.
- SAIC. 1994. Archaeological Extended Survey Report for the Santa Ynez Extension and Mission Hills Extension, Santa Barbara County, California. Science Applications International Corporation, Santa Barbara, California. Submitted to the Central Coast Water Authority, Santa Barbara, California.
- SCAQMD. 1999. CEQA Air Quality Handbook.
- Shipman, G.E. 1972. Soil survey of Santa Barbara County, northern Santa Barbara area. U.S. Department of Agriculture, Soil Conservation Service. Washington D.C.
- Shipman, G.E. 1981. Soil survey of Santa Barbara County, south coastal part. U.S. Department of Agriculture, Soil Conservation Service. Washington D.C.
- Spanne, L.W. 1973. Excavations at the Barka Slough Site (SBA-1010), Vandenberg Air Force Base, California. University of California, Santa Barbara (VAFB-1973-01).
- Spanne, L.W. 1974. Archaeological Survey of Vandenberg Air Force Base, Santa Barbara County, California 1971–1973. University of California, Santa Barbara. Submitted to USDI National Park Service, San Francisco, Contract No. NPS-4970P11194.
- SRS. 2006. Special-status Crustacean Surveys at Vandenberg Air Force Base, Santa Barbara County, California, November 2004-April 2006. 23 October. 20 pp.
- SRS. 2007. Survey Results for Three Federally Endangered Plants on Vandenberg Air Force Base, California. 1 November, 2007. 43 pp. plus Appendix.

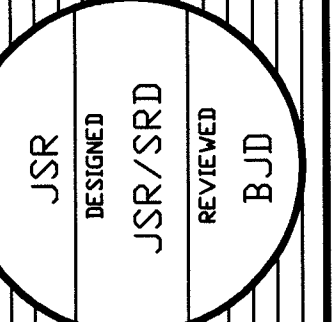

- Stone, D.F. 1985. Archaeological Survey Report for a Proposed Creekbank and Bridge Stabilization Project on San Antonio Creek and Santa Barbara County S-20 Road Bridge Crossing Stabilization (P.M. 2.25). County Archaeologist, Division of Environmental Review, Resource Management Department, County of Santa Barbara. Submitted to California Department of Transportation, Heritage Preservation Coordinator, District 5, San Luis Obispo.
- Stone, D.F. 1986a. Addendum: Archaeological Survey Report for a Proposed Road and Bridge Stabilization Project on San Antonio Creek and Santa Barbara County S-20 Road Bridge Crossing (P.M. 2.25). County Archaeologist, Division of Environmental Review, Resource Management Department, County of Santa Barbara. Submitted to California Department of Transportation, Heritage Preservation Coordinator, District 5, San Luis Obispo.
- Stone, D.F. 1986b. Historic Property Survey Report, San Antonio Creek Bridge and Bank Stabilization Project. County Archaeologist, Division of Environmental Review, Resource Management Department, County of Santa Barbara. Prepared for County of Santa Barbara, Public Works Department, Santa Barbara, California.
- Swift, C. 1999. Special-status Report for San Antonio Creek, Vandenberg AFB, California. USAF Contract #F04684-95-C-0045 to Tetra Tech. Tetra Tech. 1997. San Antonio Creek Short-term Flood Control. Draft Environmental Assessment.
- Swift, C.C., P. Duangsitti, C. Clemente, K. Hasserd, and L. Valle. 1997. Final Report: Biology and Distribution of the tidewater goby, *Eucyclogobius newberryi*, on Vandenberg Air Force Base, Santa Barbara County, California. Department of Biology, Loyola Marymount University, Los Angeles, California. 44 pp.
- Tetra Tech. 1997. San Antonio Creek Short-term Flood Control. Draft Environmental Assessment.
- Tetra Tech. 2000. Hydrology and Sediment Transport for the El Rancho Road Bridge Project, Vandenberg Air Force Base, California.
- Tetra Tech. 2002. Final Design Alternatives, Evaluation of Erosion Control Alternatives for San Antonio Creek, Vandenberg Air Force Base, California.
- The Nature Conservancy. 1995. Riparian Assessment and Woodland Management Plan for the San Antonio and Santa Ynez Riparian Areas, Vandenberg Air Force Base, California. Prepared by California Polytechnic State University, Biological Department, San Luis Obispo, California.
- Thorne, R.M. 1993. Prestabilization Assessment of Archaeological Sites on Vandenberg Air Force Base, Santa Barbara County, California. Center for Archaeological Research, University of Mississippi. Submitted to USDI National Park Service, Western Regional Office, San Francisco.
- Thorne, R.M., and W. Waldron. 1985. Historic Property Survey Report, San Antonio Creek Bridge and Bank Stabilization Project. California Department of Transportation, District 5, San Luis Obispo, California. Prepared for County of Santa Barbara Public Works, Santa Barbara, California.
- Thorson, P.H. J.K. Francine, E.A. Berg, L.E. Fillmore, and D.A. Eidson. 2001. Acoustic Measurement of the 21 September 2000 Titan II G-13 Launch and Quantitative Analysis of Behavioral Responses for Selected Pinnipeds on Vandenberg Air Force Base, CA. SRS Technologies technical report submitted to the United States Air Force and the National Marine Fisheries Service. 29pp.
- Transportation Research Board. 2005. National Cooperative Highway Research Program Report 544, Environmentally Sensitive Channel- and Bank- Protection Methods. Washington, D.C.

- URS Corporation. 1986. San Miguel Project and Northern Santa Maria Basin Area Study – Final Environmental Impact Statement, Environmental Impact Report. Prepared for County of San Luis Obispo, Minerals Management Service, State Lands Commission, County of Santa Barbara, California Coastal Commission, and California Office of Offshore Development. October 1986.
- USACE. 1987. Corps of Engineers Wetlands Delineation Manual. Technical Report Y-87-1. US Army Engineer Waterways Experiment Station, Vicksburg, MS.
- USACE. 1998. Alternatives Analysis Report San Antonio Creek Crossing Alternatives, Vandenberg Air Force Base, Volumes I and II.
- USACE. 1999. Draft Environmental Assessment for Proposed Erosion Repair Improvements and After-the-Fact Assessment of Emergency Erosion Repairs. San Antonio Creek, Vandenberg Air Force Base, California. February.
- USACE. 2004. Hydrology and Hydraulic Analysis and River Geomorphology Assessment of the San Antonio Creek in Santa Barbara, California.
- USAF. 1987. Mineral resource management plan: Potential exploration, development, and production of oil and gas resources, Vandenberg Air Force Base.
- USAF. 1998. Final environmental assessment for installation of Tranquillion Mountain fiber-optic cable system, Vandenberg Air Force Base, California.
- USAF. 2002. Final Environmental Impact Statement for El Rancho Road Bridge Project, Vandenberg Air Force Base, California.
- USFWS. 1985. Revised Unarmored Threespine Stickleback Recovery Plan. Portland, Oregon. December 26. 80 pp.
- USGS. 2008. Central Coast Ambient Monitoring Program, San Antonio Creek at San Antonio Road West. Retrieved from <http://www.ccamp.org/ca300/3/Sites/313sai/313SAI.htm> on 24 April 2008.
- VAFB. 2007. Vandenberg Air Force Base General Plan.
- VAFB. *In Progress*. Preliminary Draft Integrated Natural Resources Management Plan, Vandenberg Air Force Base, California.
- WESTEC Services, Inc. 1981. Geophysical Evaluation, Vandenberg Air Force Base, Santa Barbara County, California, for Union Oil Company of California. WESTEC Services, Inc., Tustin, California. Submitted to Union Oil Company, Ventura, California.
- WESTEC Services, Inc. 1982. Environmental Assessment, Union Oil Company of California Exploration Project, Vandenberg Air Force Base. WESTEC Services, Inc., Santa Ana, California. Submitted to Union Oil Company of California, Ventura.
- WESTEC Services, Inc. 1983. Environmental Assessment, Conoco, Inc. Oil Exploration Project, Vandenberg Air Force Base, California. WESTEC Services, Inc., Tustin, California. Submitted to Conoco, Inc., Ventura, California.
- Wilcoxon, L.R., and B.D. Haley. 1996. A Phase I Cultural Resource Evaluation for GTE Mobilnet's Vandenberg Cellular Telephone Relay Station, Vandenberg AFB, Santa Barbara County, California. On file, California Historical Resources Information System, Central Coast Information Center, University of California, Santa Barbara.

- Woodman, C.F. 1997. Final Technical Report: Survey and Evaluation at the Barka Slough Kill Site, CA-SBA-1010, Vandenberg Air Force Base, Santa Barbara County, California. Science Applications International Corporation, Santa Barbara, California. Submitted to USDI National Park Service, Western Region Interagency Archeological Services Branch, San Francisco.
- Woodman, C.F., and D. McDowell. 1989. The Archaeological Survey of Three Federal Prison Camp Projects on Vandenberg Air Force Base. Craig F. Woodman, Consulting Archaeologist, Santa Barbara, California. Submitted to Federal Prison Camp, Lompoc, California.
- Woodman, C.F., T. Morgan, and W. Ellersieck. 1985. Archaeological and Geomorphological Investigations of SBA-1010 and nearby Areas, Vandenberg Air Force Base, Santa Barbara County, California. URS Corporation, Santa Barbara, California. Prepared for Santa Barbara County Department of Public Works, Santa Barbara, California.
- Worts, G.F. Jr. 1951. Geology and Groundwater Resources of the Santa Maria Valley Area, California. U.S. Geological Survey Water Supply Paper 1000.

APPENDIX A

Engineering Plan Views and Typical Details

[illegible]

BRAVING TITLE	TITLE SHEET	DATE
SAN ANTONIO CREEK STREAM RESTORATION		02/22/08
SCALE	AS NOTED	

REGISTERED PROFESSIONAL ENGINEER
BRIAN J. DOERING
No. 40884
Exp. 9-20-08
CIVIL
STATE OF CALIFORNIA

PROJECT #
9-1128B2
DRAWING #
G001
1 OF 9
SHEET #

PLANTINGS

1. ALL DSAs WILL RECEIVE THE STANDARD TREATMENT WHICH INCLUDES:
- A. SOIL PREPARATIONS [SURFACE ROUGHENING AND TRACK WALKING (SHEET 9 DETAIL C)].
 - B. SOIL AMENDMENTS [AM 120 MYCORRHIZAE INOCULUM OR EQUIVALENT 60 LB/AC, BOISOL MIX 7-2-3 FERTILIZER 800 LB/AC, AND 2-IN COMPOST (IF REQUIRED, AS DIRECTED BY ONSITE ENGINEER)].
 - C. SEED MIX (AS NOTED) AND STRAW MULCH 4000 LB/AC. PLANT CREEKSIDE AREAS (BETWEEN 3 FT AND 8 FT ABOVE CHANNEL BOTTOM) WITH SEED MIX A, PLANT UPLAND AREAS (ABOVE 8-FT FROM CHANNEL BOTTOM) WITH SEED MIX B AS DIRECTED BY ONSITE ENGINEER.
2. ALL ACCESS (HAUL) ROADS AND STAGING AREAS SHALL BE PLANTED IN DISTURBED HABITAT (NON-AGRICULTURAL FIELD) AREAS ONLY.
3. ALL ACCESS (HAUL) ROADS AND STAGING AREAS SHALL ADDITIONALLY RECEIVE WILLOW PLANTINGS AT APPROXIMATELY 1 PER 80 SF OF AREA (PLANTED AREA ONLY). INSTALL PER DIRECTION OF ONSITE ENGINEER.
4. SALVAGE AND STORE JUNCUS AND CAREX DIVISIONS FROM SITE OR BARKA SLOUGH AS DIRECTED BY ONSITE ENGINEER. PLANT WITHIN DSA-2YR AREAS AND AS DIRECTED BY ONSITE ENGINEER.
5. CHANNEL BOTTOM AREAS SHALL NOT RECEIVE SEED AS DIRECTED BY ONSITE ENGINEER.

PLANTING SCHEDULE FOR DSAs		
DSA	APPROXIMATE AREA (AC)	TREATMENT
CONSTRUCTION ACCESS ROADS/STAGING AREAS	4.3*	STANDARD TREATMENT AND WILLOW POLES (1 PER 80 SF)
DSA1-SF (SITE 1)	1.4	STANDARD
DSA2-NC (SITE 1)	0.6	STANDARD
DSA3-SF (SITE 2)	0.4	STANDARD
DSA4-NC (SITE 2)	0.1	STANDARD
DSA5-NC (SITE 3)	0.1	STANDARD
C/7-N (SITE 3)	0.2	STANDARD
C/7-S (SITE 3)	0.1	STANDARD TREATMENT AND WILLOWS IN SELECTED VOIDS
DSA-5YR	0.3	STANDARD
DSA-2YR	0.6	STANDARD AND JUNCUS/CAREX DIVISIONS
OTHER DSAs CAUSED BY CONSTRUCTION	VARIES	PLANT PER PLANTING NOTES 1-5 ABOVE

* ACCESS ROADS/STAGING AREA REPORTED ONLY INCLUDES DISTURBED HABITAT (NON-AGRICULTURAL, AND NOT PREVIOUSLY DISTURBED AREAS).

SEED MIX A (CREEKSIDE)		
BOTANIC NAME	COMMON NAME	APPLICATION (LB/AC)
ARTEMESIA DOUGLASIANA	MUGWORT	2
BACCHARIS SALICIFOLIA	MULEFAT	2
CYPERUS ERAGROSTIS	UMBRELLA SEDGE	1
HORDEUM BRACHYANTHERUM	MEADOW BARLEY	8
LEYMUS TRITICOIDES	CREEPING WILD RYE	10
VULPIA MICROSTACHYS	SMALL FESCUE	6
TOTAL		29

SEED MIX B (UPLAND)		
BOTANIC NAME	COMMON NAME	APPLICATION (LB/AC)
BACCHARIS PILULARIS	COYOTE BUSH	3
BROMUS CARINATUS	CALIFORNIA BROME	6
ESCHSCHOLZIA CALIFORNICA	CALIFORNIA POPPY	1
HETEROMELES ARBUTIFOLIA	TOYON	2
LASTHENIA GLABRATA	GOLDFIELDS	1
LEYMUS CONDENSATUS	GIANT WILD RYE	3
LIPUNUS BICOLOR	DOVE LUPINE	3
MIMULUS AURANTIACUS LOMPOCENSIS	LOMPO MONKEY FLOWER	3
NASSELLA PULCHRA	PURPLE NEEDLEGRASS	6
PHACELIA RAMOISSIMA	BRANCHING PHACELIA	2
SAMBUCUS MEXICANA	ELDERBERRY	1
VERBENA LASIODTACHYS	WESTERN VERNAIN	2
TOTAL		33

GENERAL CONSTRUCTION NOTES

1. SEE DETAIL SHEETS FOR GRADE CONTROL DIMENSIONS AND ELEVATIONS.
2. FOLLOW VEGETATION PLAN AS SHOWN ON PLANS AND NOTED IN SPECIFICATIONS. GENERAL EROSION CONTROLS SHALL BE IMPLEMENTED IN ALL DISTURBED SOIL AREAS IN ADDITION TO PLANTINGS NOTED TO THE LEFT.
3. WATER SHALL BE SPRAYED TO ROADS AND OTHER CONSTRUCTION AREAS TO PREVENT DUST AS NEEDED.
4. CONTRACTOR SHALL NOT ALLOW ANY FILL MATERIAL, ROCK RIP RAP OR OTHER SUBSTANCES TO BE DISCHARGED INTO SAN ANTONIO CREEK.
5. CARE SHALL BE TAKEN TO PRESERVE ALL LIVE LARGE TREES OR SHRUBS THAT MAY BE ENCOUNTERED DURING CONSTRUCTION. LARGE LIVE TREES OR ROOT BALLS SHALL BE PROTECTED TO THE EXTENT POSSIBLE BY CAREFULLY PLACING FILL UNDER EXPOSED AREAS TO PROMOTE STABILITY AND IMPROVE THE TREES LONG-TERM HEALTH AND SURVIVAL. UPROOTED TREES NEED NOT BE PRESERVED AS DESCRIBED ABOVE.
6. CONTRACTOR SHALL NOT USE AREAS BEYOND TEMPORARY WORK LIMITS.
7. MATERIALS FROM EXISTING STREAM MAY BE RELOCATED ON SITE PER THE ONSITE ENGINEER.
8. GRADING LIMITS IN OVERBANK AREAS IN BETWEEN GRADE CONTROL STRUCTURES ARE BASED ON AREAS REQUIRED TO BALANCE CUT AND FILL VOLUMES. THESE MAY BE FIELD ADJUSTED AS NECESSARY WITH VAFB AND ONSITE ENGINEER APPROVAL.
9. ALL DIMENSIONS ARE FEET UNLESS OTHERWISE NOTED.
10. SITE 1 CONTAINS G/C 6 AND 7. SITE 2 CONTAINS G/C 3, 4, AND 5. SITE 3 CONTAINS G/C 1 AND 2.
11. THE VADOSE ZONE, CAPILLARY FRINGE, AND SEASONAL SATURATION ZONE ARE SHOWN FOR INFORMATIONAL PRURPOSES AND WILL BE LOCATED BY THE ONSITE ENGINEER.
12. ONSITE ENGINEER SHALL BE DESIGNATED BY VAFB AND MAY MAKE MINOR FIELD MODIFICATIONS TO THESE DESIGN PLANS. MAJOR DESIGN MODIFICATIONS SHALL REQUIRE APPROVAL OF THE ENGINEER OF RECORD.

SURVEY NOTES

1. HORIZONATAL DATUM USED IN THESE PLANS IS CALIFORNIA COORDINATE SYSTEM NAD 1983 ZONE V HPGN (FEET), VERTICAL DATUM IS NAVD 1988 (FEET). GRID POINTS SHOWN ARE SPACED AT 200 FT.
2. EXISTING TOPOGRAPHIC SURVEY SHOWN ON THESE PLANS IS BASED ON DATA FROM 2005 LIDAR MAPPING PROVIDED BY VAFB. FIELD SURVEYS TO VERIFY THIS DATA WERE PERFORMED IN AUGUST 2006 BY ANDREGG GEOMATICS. AN ADDITIONAL THALWEG SURVEY WAS PERFORMED BY ANDREGG IN MAY 2007. THE MAY 2007 SURVEY PROFILE IS PRESENTED ON SHEETS C1401 AND C1402 IN THESE DRAWINGS. HOWEVER, DIFFERENCES DO EXIST BETWEEN THE PLAN VIEW TOPOGRAPHY AND THE PROFILE SURVEY ELEVATIONS.
3. UTILITY INFORMATION INFORMATION SHOWN ON THESE DRAWINGS IS APPROXIMATE, NOT COMPREHENSIVE AND IS INCLUDED FOR REFERENCE ONLY. OFFICIAL DETERMINATION OF UTILITY LOCATIONS IN WORK AREAS SHOULD BE PERFORMED BY CONTRACTOR PRIOR TO WORK BY OBTAINING A PERMIT FROM VAFB AF FORM 103.
4. EXISTING TOPOGRAPHIC CONTOUR INTERVAL IS 2 FT. PROPOSED FILL SLOPES AND CUT/FILL AREA CONTOUR INTERVALS ARE 2 FT.
5. CONSTRUCTION STAKING POINTS NOTED BELOW ARE APPROXIMATE AND MAY NEED TO BE FIELD MODIFIED PER ONSITE ENGINEER.


CONSTRUCTION STAKING POINTS			
POINT	N	E	FINAL GRADE ELEV
A	2114417.42	5812470.20	185.00
B	2114283.98	5812267.83	183.70
C	2114351.53	5812063.49	183.40
D	2114346.01	5811755.14	181.60
E	2114689.63	5810242.78	166.30
F	2114628.68	5810129.72	164.00
G	2114747.56	5809973.11	164.00
H	2115345.19	5809192.90	159.60
I	2115397.75	5809099.81	159.10

EARTHWORK


APPROXIMATE EARTHWORK VOLUMES		
	CUT (CY)	FILL (CY)
SITE 1	40,100	43,600
SITE 2	8,600	5,700
SITE 3	2,900	600
TOTAL	51,600	46,000

1. CUT AND FILL VOLUMES ARE REPORTED IN-PLACE. NO ALLOWANCE IS MADE FOR SHRINKAGE OR SWELL.
2. SITE EARTHWORK VOLUMES INCLUDE VOLUMES FOR GRADE CONTROL STRUCTURES PER NOTE 10 ABOVE.

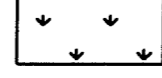
LEGEND



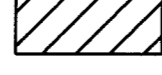
ROCK RIPRAP



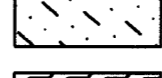
GRANULAR FILTER OR GRANULAR BEDDING



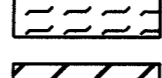
PLANTING AREA



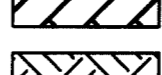
FILL



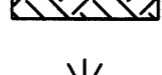
EXISTING SOIL




VEGETATED MECHANICALLY STABILIZED EARTH




EXISTING CONCRETE RUBBLE




GEOTEXTILE COVERED WITH STONE (TEMPORARY ACCESS AREA PROTECTION)




WILLOW POLE PLANTING




FILL SLOPE




CUT SLOPE




WATER SURFACE ELEVATION




SEE CONSTRUCTION STAKING POINT X ON SHEET 2




GT('X') IDENTIFICATION AND APPROXIMATE LOCATION OF GEOTECHNICAL TESTING. SEE FUGRO (2008) FOR RESULTS.



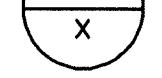
SURVEY BENCHMARK



GRID MARK (200 FT CCS NAD 83 ZONE V)



CREATE ACCESS (HAUL) ROAD AND/OR STAGING AREA AS SHOWN (SUBJECT TO FIELD DIRECTION, MINIMAL AMOUNT NEEDED, ENVIRONMENTAL AND CULTURAL RESOURCE CONSTRAINTS, AND MOST SUITABLE SITE CONDITIONS). FOR ACCESS THROUGH VEGETATED AREAS CLEAR A 15 FT WIDE BY 15 FT HIGH CORRIDOR AS DIRECTED BY ONSITE ENGINEER.

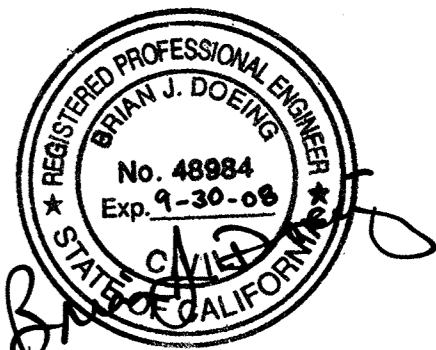


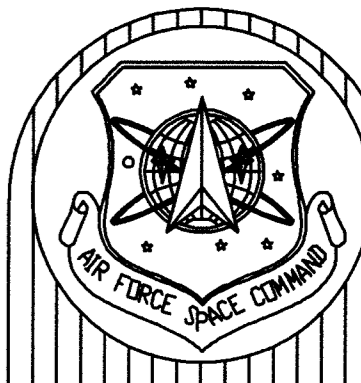
PLAN, DETAIL, OR SECTION CALLOUT SEE A ON SHEET X. "..." REFERS TO SAME SHEET.

ABBREVIATIONS

AHW	APPROXIMATE HIGH WATER ELEVATION
ALW	APPROXIMATE LOW WATER ELEVATION
CCS	CALIFORNIA COORDINATE SYSTEM
CL	CENTERLINE
CM	CENTIMETER
CMP	CORRUGATED METAL PIPE
COM	COMMUNICATIONS LINE
CP	CONTROL POINT
CPESC	CERTIFIED PROFESSIONAL IN EROSION AND SEDIMENT CONTROL
DIAM	DIAMETER
DSA	DISTURBED SOIL AREA
EL, ELEV	ELEVATION
EXIST	EXISTING
FOL	FIBER OPTIC LINE
FT	FOOT/FEET
G/C	ROCK RIFLE GRADE CONTROL STRUCTURE
GA	GUY ANCHOR
GP	GUY POLE
GT	GEOTECHNICAL TESTING
HORIZ	HORIZONTAL
IN	INCH/INCHES
LPST	LONGITUDINAL PEAK STONE TOE
MAX	MAXIMUM
MIN	MINIMUM
NTS	NOT TO SCALE
OHP	OVERHEAD POWER LINE
PP	POWER POLE
SF	SQUARE FEET
STA	STATION
T/S	TREE AND SHRUB
TYP	TYPICAL
VERT	VERTICAL
WL	WATER LINE
WSEL	WATER SURFACE ELEVATION

100% SUBMITTAL
ISSUED FOR CONSTRUCTION





U.S. AIR FORCE
SPACE COMMAND
VANDENBERG AFB

PROJECT TITLE
SAN ANTONIO CREEK
STREAM RESTORATION

DRAWING TITLE
GENERAL CONSTRUCTION NOTES

SCALE
AS NOTED

DATE
02/22/08

PROJECT #
09-1128B2

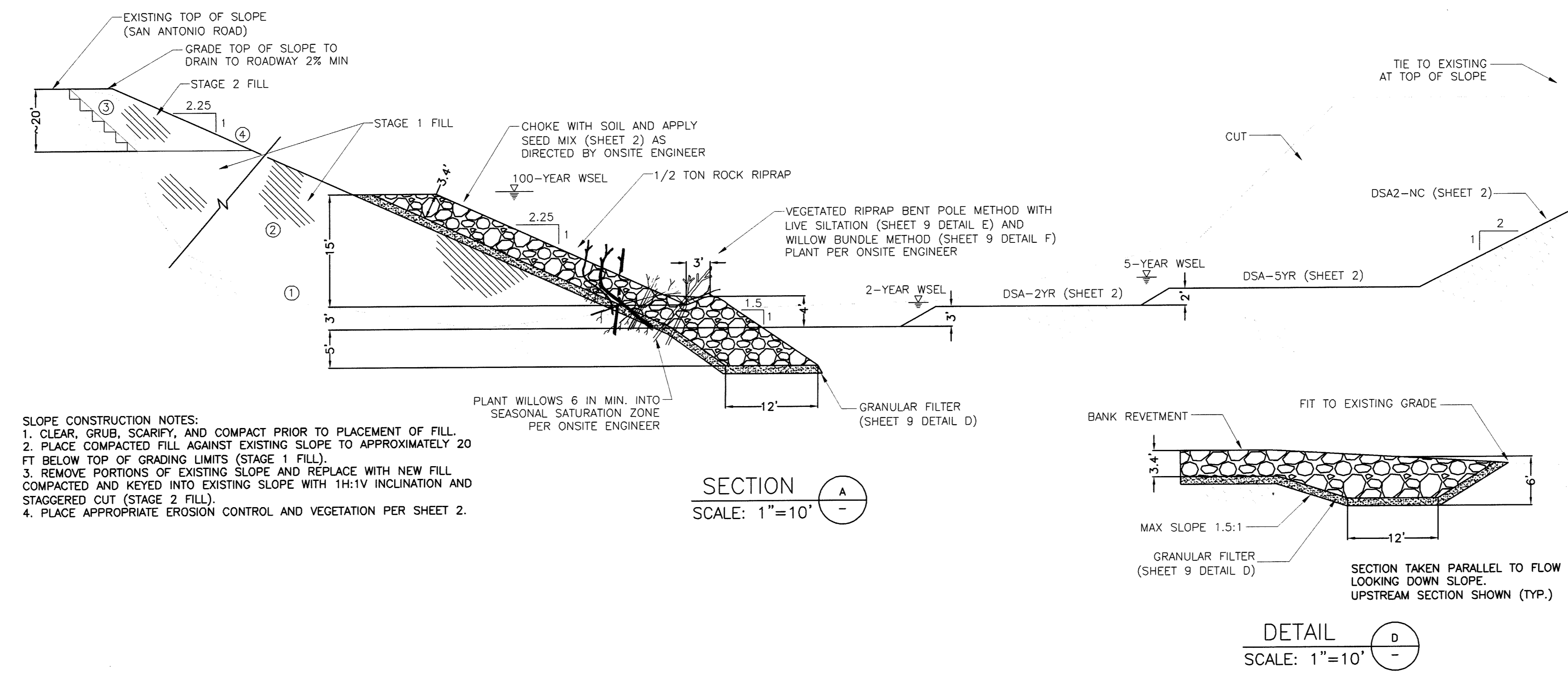
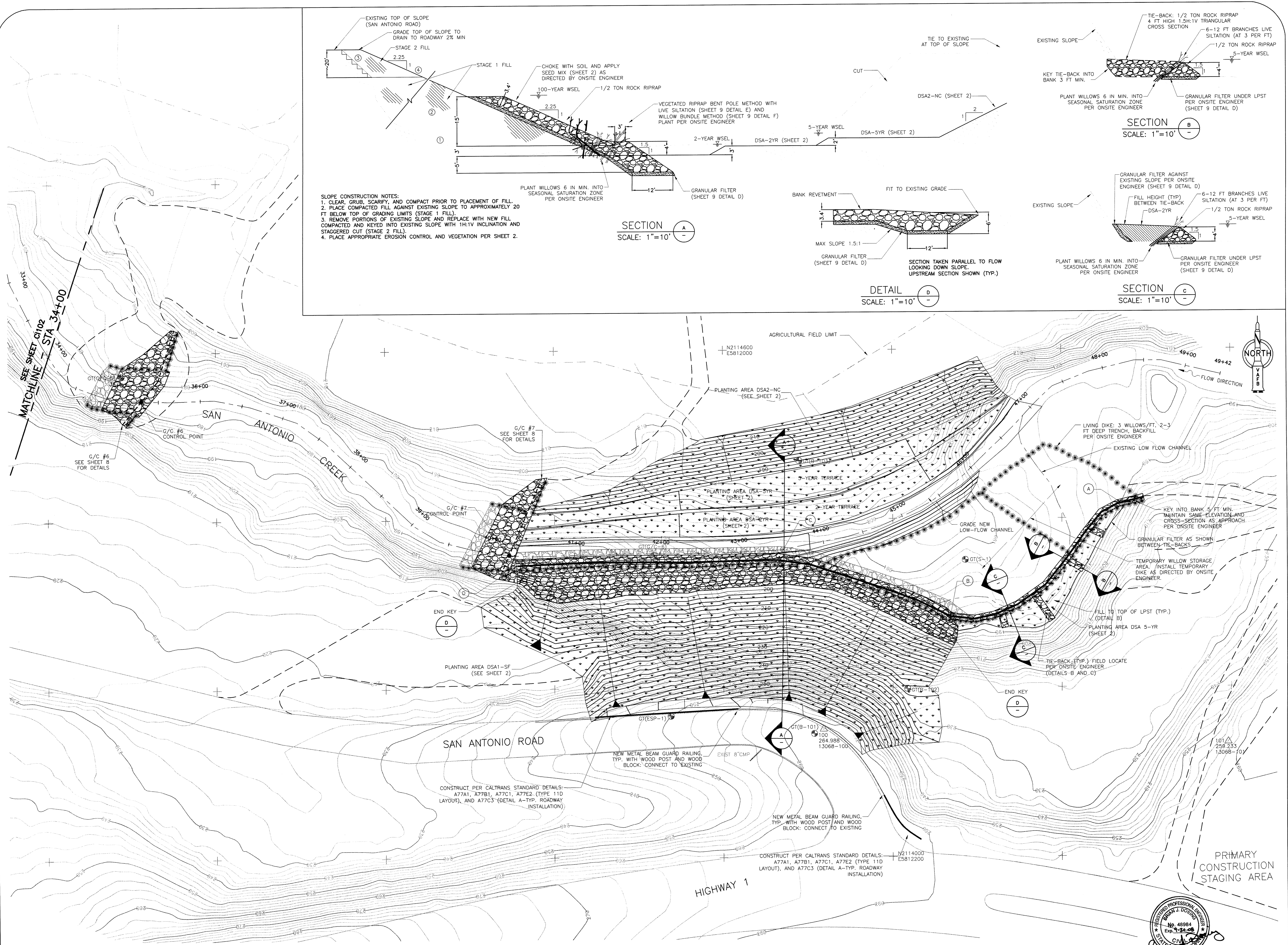
DRAWING #
G002

2 OF 9
SHEET #

FOR OFFICIAL USE ONLY - INFORMATION APPLICATIONS IS REQUIRED

The information contained on this drawing shall remain the property of the Department of Defense and shall not be released to the public in whole or in part without the express written approval of the Department of Defense. This drawing is the property of the Department of Defense and shall not be released to the public in whole or in part without the express written approval of the Department of Defense. This drawing is the property of the Department of Defense and shall not be released to the public in whole or in part without the express written approval of the Department of Defense. This drawing is the property of the Department of Defense and shall not be released to the public in whole or in part without the express written approval of the Department of Defense.

DO NOT SCALE THIS DRAWING - ALL DIMENSIONS SHOWN ON IT



SLOPE CONSTRUCTION NOTES:
1. CLEAR, GRUB, SCARIFY, AND COMPACT PRIOR TO PLACEMENT OF FILL.
2. PLACE COMPACTED FILL AGAINST EXISTING SLOPE TO APPROXIMATELY 20 FT BELOW TOP OF GRADING LIMITS (STAGE 1 FILL).
3. REMOVE PORTIONS OF EXISTING SLOPE AND REPLACE WITH NEW FILL COMPACTED AND KEYED INTO EXISTING SLOPE WITH 1H:1V INCLINATION AND STAGGERED CUT (STAGE 2 FILL).
4. PLACE APPROPRIATE EROSION CONTROL AND VEGETATION PER SHEET 2.

SITE 1 - PLAN

100% SUBMITTAL
ISSUED FOR CONSTRUCTION

SCALE: 1" = 40'-0"

FOR OFFICIAL USE ONLY - INFORMATION SAFEGUARDING IS REQUIRED

THE INFORMATION CONTAINED HEREIN IS UNCLASSIFIED EXCEPT WHERE SHOWN OTHERWISE. IT IS THE POLICY OF THE AIR FORCE TO MAKE AVAILABLE TO THE PUBLIC INFORMATION THAT DOES NOT RELATE TO NATIONAL DEFENSE. INFORMATION CONTAINED HEREIN IS UNCLASSIFIED EXCEPT WHERE SHOWN OTHERWISE. IT IS THE POLICY OF THE AIR FORCE TO MAKE AVAILABLE TO THE PUBLIC INFORMATION THAT DOES NOT RELATE TO NATIONAL DEFENSE.

DO NOT DUPLICATE THIS DRAWING - OR THE DATA CONTAINED ON IT

DATE	DESCRIPTION OF REVISION	SYMBOL	DRAWN	DESIGNED	REVIEWED	BJD
			JSR	JSR/SRD		

PROJECT TITLE

SAN ANTONIO CREEK
STREAM RESTORATION

DRAWING TITLE

SITE 1 - IMPROVEMENT PLAN

SCALE

AS NOTED

DATE

02/22/08

PROJECT #

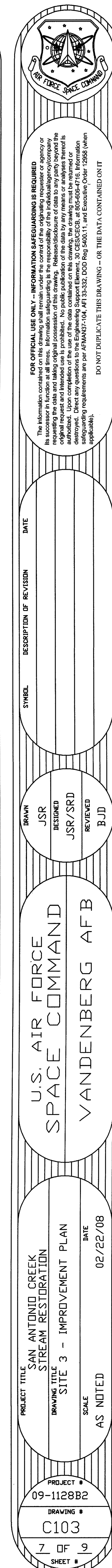
09-1128B2

DRAWING #

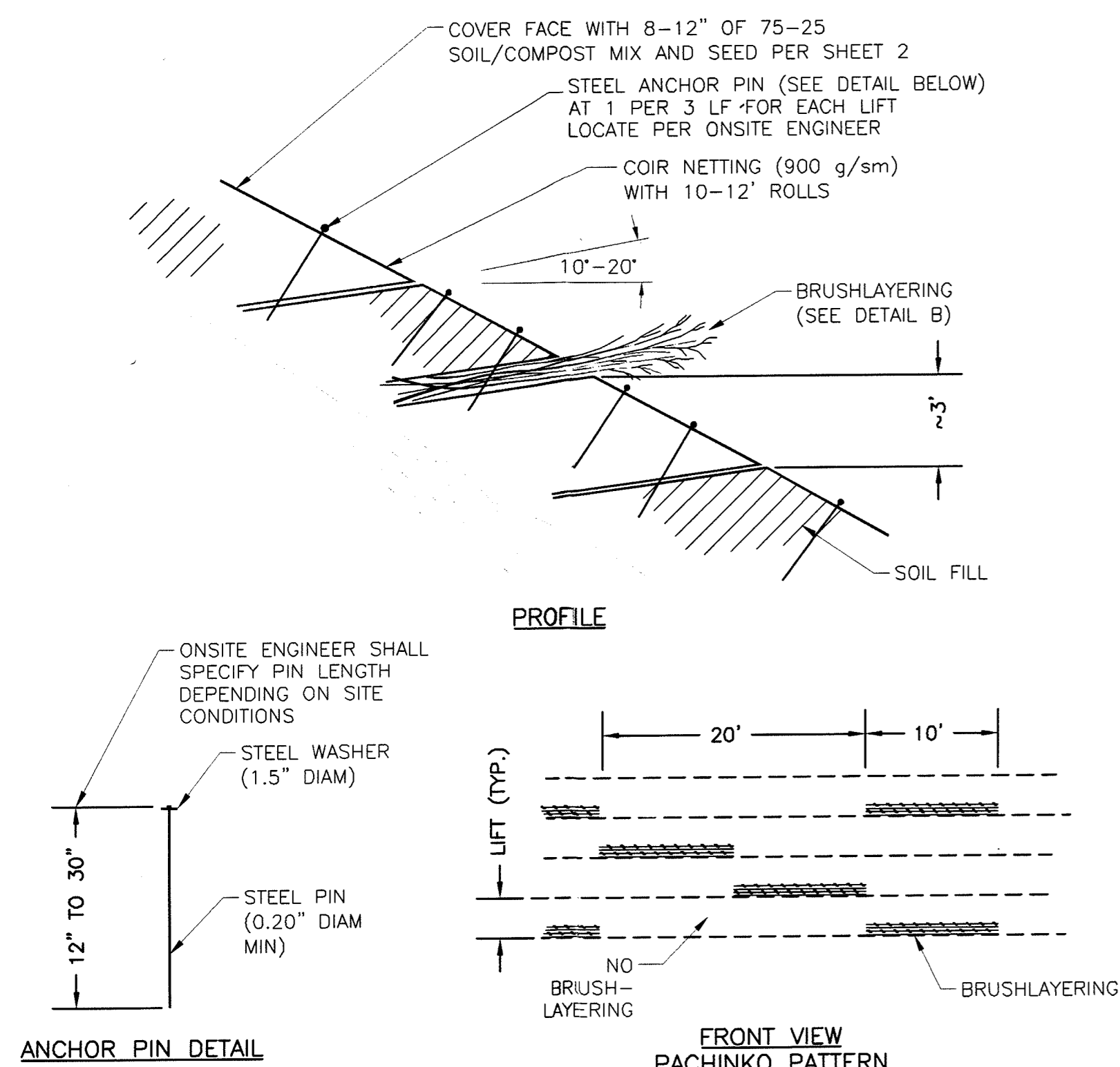
C101

SHEET #

5 OF 9



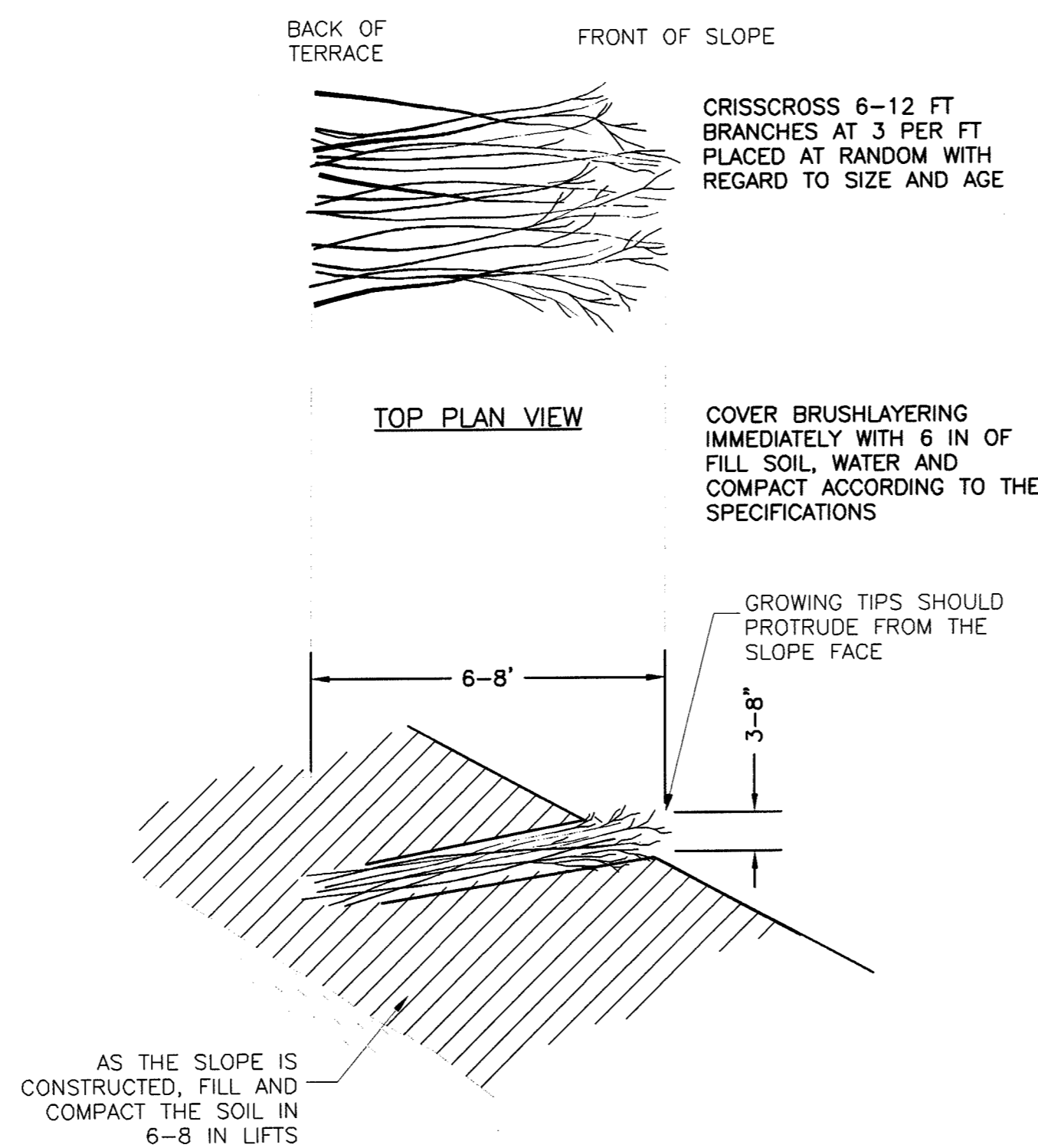
100% SUBMITTAL
ISSUED FOR CONSTRUCTION



1. EACH LIFT (TERRACE) WILL BE 3 FT VERTICAL, DIPPED BACK 10-20'. THE OUTER 3-4 FT OF TERRACE WILL BE TRACK COMPACTED ONLY.
2. ON EACH TERRACE ROLL OUT, IN THE DIRECTION OF FLOW, THE ~11 FT WIDE COIR NETTING (900g/sm), LEAVING 5 FT ON TERRACE AND FLAPPING ~6 FT OVER THE FACE OF THE SLOPE.
3. EACH TERRACE WILL HAVE 10 LF OF BRUSHLAYERING FOLLOWED BY 20 LF OF NO BRUSHLAYERING. THE BRUSHLAYERING WILL BE STAGGERED WITH THE NEXT TERRACE, FOLLOWING THE PACHINKO PATTERN (SEE DETAIL) AND PER THE ONSITE ENGINEER.
4. THE OUTER 8-12 IN OF FACE WILL HAVE A 75% SOIL FILL, 25% COMPOST MIX (NOT COMPACTED) AND KEPT AT 15-20% MOISTURE.

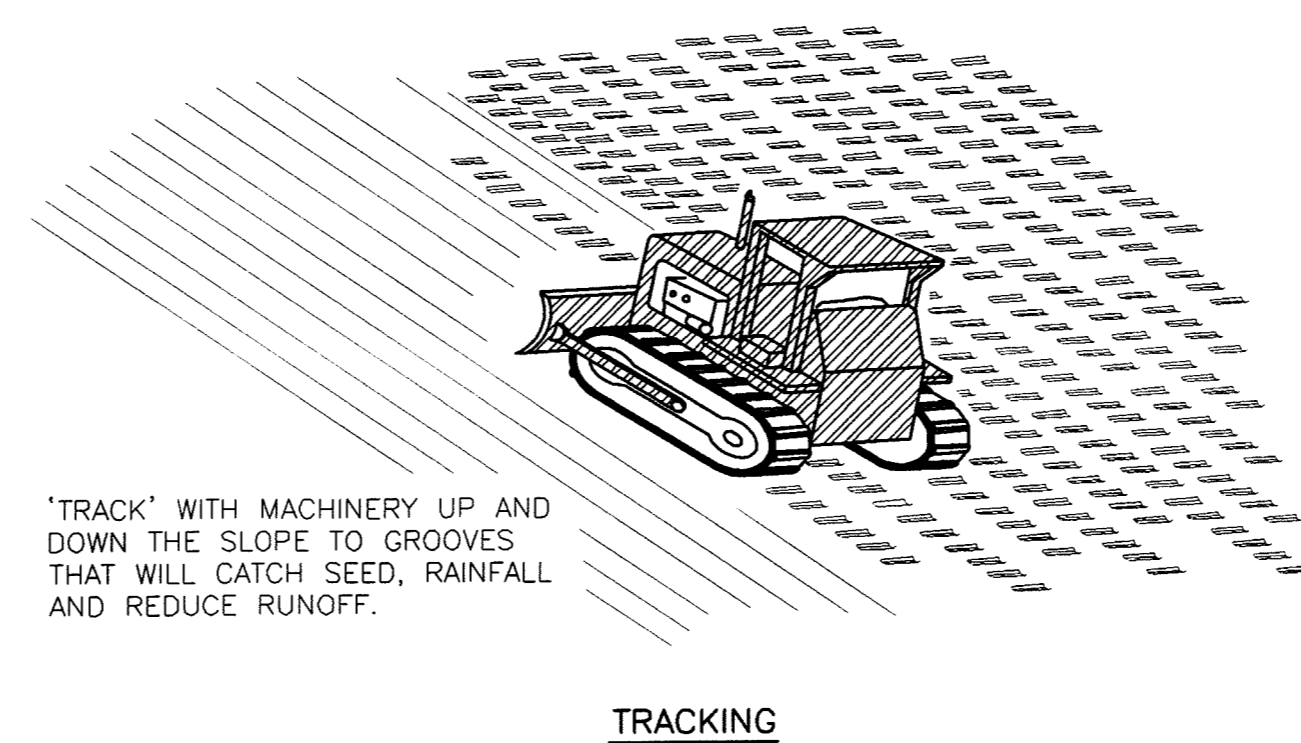
TYP. MODIFIED VEGETATED MECHANICALLY STABILIZED EARTH (SOIL FLAP METHOD)

DETAIL A
SCALE: NTS



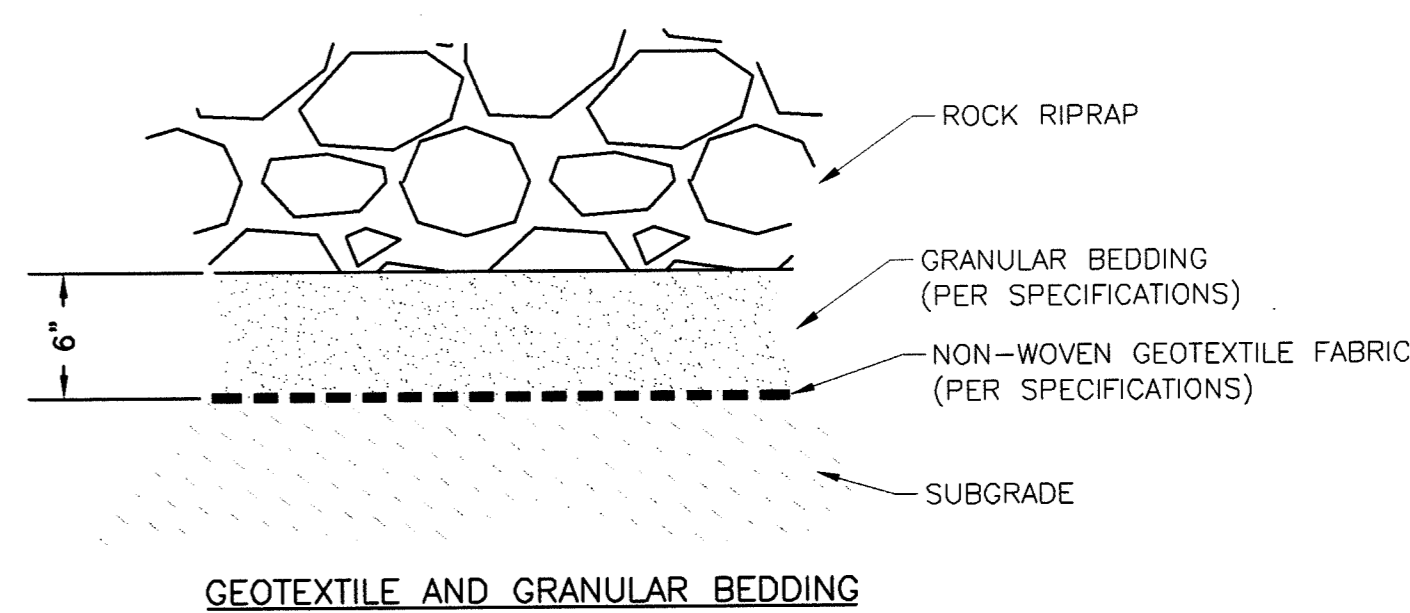
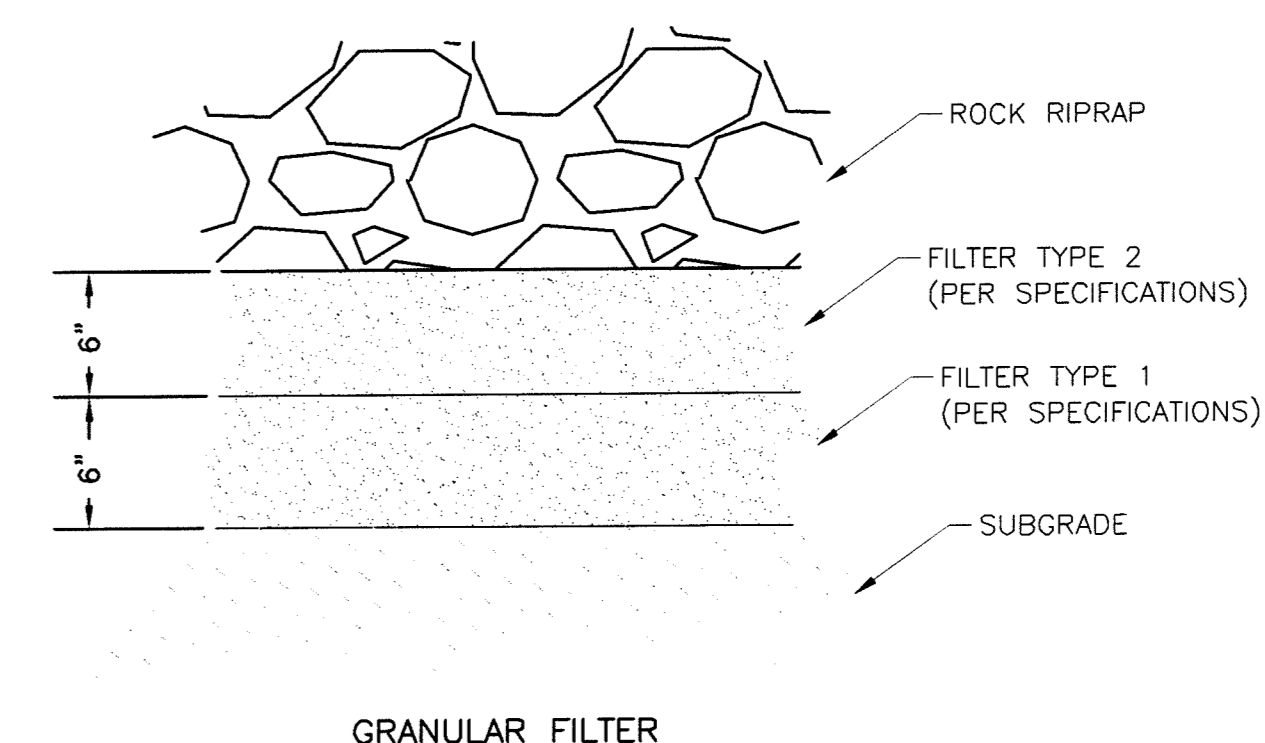
TYPICAL BRUSHLAYERING WITH SLOPE PROTECTION

DETAIL B
SCALE: NTS

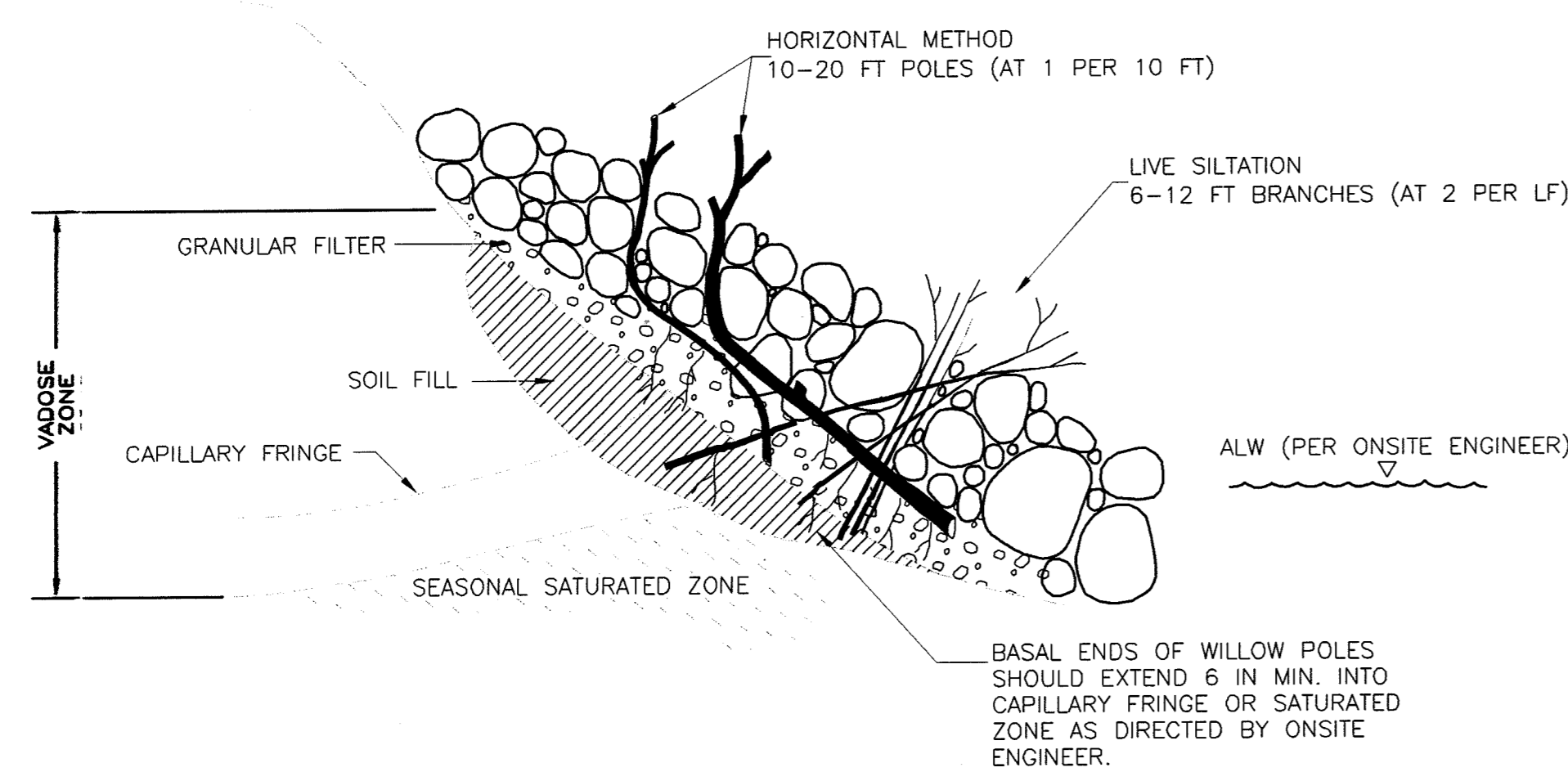


SOURCE: SALIX EARTHCARE INC.

DETAIL C
SCALE: NTS



DETAIL D
SCALE: NTS



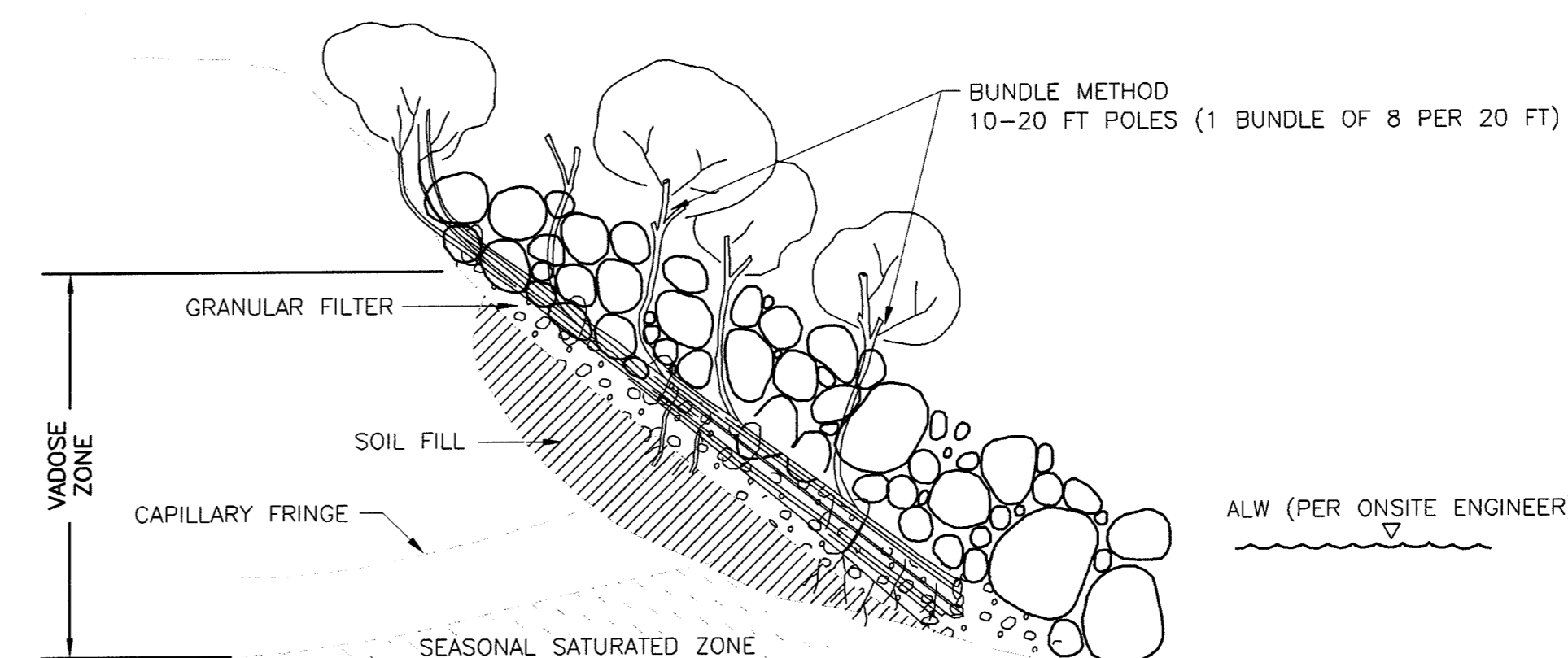
NOTES:

1. INTEGRATE POLE PLANTING AND LIVE SILTATION TECHNIQUES DURING ROCK PLACEMENT TO ENSURE CONTACT WITH NATIVE GROUND AS DIRECTED BY ONSITE ENGINEER.
2. AS A GENERAL RULE, PLACE BASAL ENDS OF THE CUTTINGS 6 IN INTO THE CAPILLARY FRINGE OR SEASONAL SATURATED ZONE AS DIRECTED BY ONSITE ENGINEER.
3. PLACE SOIL FILL, FERTILIZER AND MYCORRHYZAE AROUND CUTTINGS AND "WATER IN" IF POSSIBLE AS DIRECTED BY ONSITE ENGINEER.
4. CONSTRUCT GRANULAR FILTER AND ROCK RIPRAP AS SHOWN IN PLANS AND AS DIRECTED BY ONSITE ENGINEER. DO NOT DAMAGE WILLOW POLES DURING ROCK PLACEMENT.
5. VADOSE ZONE, CAPILLARY FRINGE, AND SEASONAL SATURATION ZONE TO BE LOCATED BY ONSITE ENGINEER.

VEGETATED RIPRAP BENT POLE METHOD (HORIZONTAL)

SOURCE: SALIX EARTHCARE INC.

DETAIL E
SCALE: NTS



NOTES:

1. INTEGRATE WILLOW BUNDLE METHOD DURING ROCK PLACEMENT TO ENSURE CONTACT WITH NATIVE GROUND AS DIRECTED BY ONSITE ENGINEER.
2. BEND INDIVIDUAL POLES UP THROUGH THE RIPRAP DURING PLACEMENT WHILE ENSURING CONTACT OF THE STEM WITH NATIVE GROUND AS DIRECTED BY ONSITE ENGINEER.
3. PLACE SOIL FILL, FERTILIZER AND MYCORRHYZAE AROUND CUTTINGS AND "WATER IN" IF POSSIBLE AS DIRECTED BY ONSITE ENGINEER.
4. CONSTRUCT GRANULAR FILTER AND ROCK RIPRAP AS SHOWN IN PLANS AND AS DIRECTED BY ONSITE ENGINEER. DO NOT DAMAGE WILLOW POLES DURING ROCK PLACEMENT.
5. VADOSE ZONE, CAPILLARY FRINGE, AND SEASONAL SATURATION ZONE TO BE LOCATED BY ONSITE ENGINEER.

VEGETATED RIPRAP WILLOW BUNDLE METHOD (HORIZONTAL)

SOURCE: SALIX EARTHCARE INC.

DETAIL F
SCALE: NTS

100% SUBMITTAL
ISSUED FOR CONSTRUCTION



U.S. AIR FORCE SPACE COMMAND VANDENBERG AFB	
PROJECT TITLE SAN ANTONIO CREEK STREAM RESTORATION	DRAWING TITLE TYPICAL DETAILS
DATE 02/22/08	SCALE AS NOTED
PROJECT 09-1128B2	DRAWING # C502
9 OF 9 SHEET #	9

APPENDIX B

Air Quality Analysis

Appendix B. Air Quality Analysis

Construction data provided by 30 CES Engineering Flight were used to prepare this analysis. The procedures and equations used to calculate the air emissions are detailed below.

B.1 Technical Assumptions and Emission Calculation

B.1.1 Proposed Action

The Proposed Action, described in detail in the Environmental Assessment, would install and construct various restoration and erosion control measures along a 0.875-mile stretch of San Antonio Creek on Vandenberg Air Force Base (VAFB), between U.S. Highway 1 and the Lee Road Utility Bridge. Components to be constructed include in-stream-rock-riffle grade controls at seven sites, and bioengineering bank stabilization at three sites, which include longitudinal peak stone toe protection and floodplain terraces. The estimated project area encompasses approximately 149 acres, with approximately 3.8 acres of riparian habitat created, and an estimated disturbance area from construction equipment and activities of 40 acres. Construction activities would occur during calendar year 2008 and last for approximately 40 workdays.

Table B-1 presents equipment usages for the estimated reasonable daily worst-case scenario, including equipment size and load factors. Table B-2 shows the emissions factors used to estimate the emissions, and Tables B-3 and B-4 show the reasonable worst-case daily and total project emissions. Because implementation would occur in 2008, emissions were estimated using 2008 emission factors.

Sources of air emissions from projects included under the Proposed Action would include combustive and fugitive emissions. Combustive emission would come from construction equipment, employee commuting, and trucks. Fugitive emissions would come from equipment disturbing the construction site.

B.1.2 Combustive Emissions

For combustive emissions from construction equipment, the daily emissions were calculated by multiplying the equipment horsepower, the load factor, the emission factor, the number of equipment and the hours of operation for a day. Project emissions were calculated by multiplying the equipment horsepower, the load factor, the emission factor, the number of equipment, and the hours of operation during the project. As shown in Table B-1, the default horsepower and load factors from URBEMIS 2007 (Jones & Stokes Associates 2007) were used. Emission factors for the construction equipment, also from URBEMIS 2007 (Jones & Stokes Associates 2007), are shown in Table B-2.

Vehicular emissions from employee commuting and truck trips were estimated by multiplying the total number of trips per day, the distance traveled, and the emission factor. Project emissions were calculated by multiplying number of trips per day by the distance traveled by the number of

days in the Proposed Action by the emission factor. It was assumed the average, one-way employee commute is 20 miles, while trucks delivering materials, would travel various distances, ranging between 4 and 85 miles one way, within Santa Barbara County. Emission factors for commuting employees and trucks hauling materials were obtained from California Air Resources Board's EMFAC 2007 (v2.3) BURDEN model run by the South Coast Air Quality Management District. The emission factors for employee commuting and construction trucks are also shown in Table B-2.

B.1.3 Fugitive Dust

Equipment operating on construction sites would disturb soil and create fugitive dust. The proponent estimated that on any given day between 0.5 and 1.0 acre would be disturbed. For purposes of this analysis, the most conservative average day estimate of 1.0 acre was used. The reasonable worst case day was assumed to disturb three times the area of an average day.

Daily fugitive dust emissions were estimated by multiplying the total daily area disturbed by the hours of operation by the emission factor of 3.49 pounds of particulate matter 10 microns or less in diameter (PM₁₀) per acre per hour (Santa Barbara County Air Pollution Control District [SBCAPCD] 2007). The project emissions were estimated by multiplying daily emissions by the number of days for the Proposed Action. The 3.49 pounds per acre per hour emission factor includes a PM₁₀ fraction 0.64, and a 50 percent reduction in PM₁₀ from site watering.

Table B-1. Equipment usage for Proposed Action.

Emission Source	Fuel	Power Rating (HP)	Load Factor	Number	Daily Hours	# of Days
Excavator	Diesel	250	0.57	2	10	40
Loader	Diesel	167	0.54	1	10	40
Loader	Diesel	98	0.54	1	10	40
Chipper/Mulcher	Diesel	130	0.78	1	10	20
Water Truck	Diesel	250	0.57	2	10	40
Dump Truck (5 ton) ^(a)	Diesel	0.5	1	20	8	25
Dump Truck (30 ton) ^(a)	Diesel	4	1	4	8	25
Dump Truck (30 ton) ^(a)	Diesel	31	1	26	8	30
Dump Truck (30 ton) ^(a)	Diesel	85	1	74	8	30
Road Grader	Diesel	150	0.61	1	8	25
Dozer	Diesel	165	0.9	4	8	40
Compactor	Diesel	165	0.55	2	8	25
Forklift	Diesel	120	0.3	1	8	30
Crane	Diesel	225	0.43	1	8	30
Chainsaw	Gas	5	0.70	4	8	12
Crew truck ^(a)	Diesel	20	1	20	1	40
Fugitive Dust Worst-Case Day ^(b)		3.00			10	1
Fugitive Dust Average Day ^(b)		1.00			10	39

NOTES:

(a) Power Rating is the number of miles traveled in one-way trip, and Number is the number of one-way trips per day.

(b) Power Rating is acres disturbed per day.

Table B-2. Construction equipment emission factors.

Emission Source	Emission Factors (g/hp-hr)					Ref.	Category
	CO	NOx	PM ₁₀	ROG	SOx		
Excavator	0.894	3.527	0.122	0.331	0.004	(1)	Excavators
Loader (4 yd ³)	1.822	3.460	0.196	0.434	0.004	(1)	Tractors/Loaders/Backhoe
Loader (1.5 yd ³)	2.240	3.937	0.360	0.655	0.004	(1)	Tractors/Loaders/Backhoes
Chipper/Mulcher	3.227	6.089	0.550	1.044	0.005	(1)	Crushing/Proc. Equipment
Water Truck	0.934	3.624	0.128	0.355	0.004	(1)	Water Trucks
Dump Truck (5 tons) ^(a)	0.013614	0.044580	0.002156	0.003516	0.000041	(2)	Heavy Heavy Duty Diesel Trucks
Dump Truck (30 tons) ^(a)	0.013614	0.044580	0.002156	0.003516	0.000041	(2)	Heavy Heavy Duty Diesel Trucks
Dump Truck (30 tons) ^(a)	0.013614	0.044580	0.002156	0.003516	0.000041	(2)	Heavy Heavy Duty Diesel Trucks
Dump Truck (30 tons) ^(a)	0.013614	0.044580	0.002156	0.003516	0.000041	(2)	Heavy Heavy Duty Diesel Trucks
Road Grader	2.096	4.816	0.439	2.044	0.004	(1)	Graders
Dozer	1.822	3.460	0.196	0.434	0.004	(1)	Tractors/Loaders/Backhoes
Compactor	1.869	3.957	0.211	0.487	0.004	(1)	Rollers
Forklift	1.257	2.208	0.218	0.393	0.002	(1)	Forklift
Crane	2.849	3.024	0.117	0.304	0.003	(1)	Cranes
Chainsaw	2.150	0.002	0.001	0.684	0.001	(3)	Chainsaws >4 Hp
Crew Trucks ^(a)	0.008263	0.000918	0.000087	0.000914	0.000011	(2)	Passenger Vehicles
Fugitive Dust ^(b)			3.490			(2)	SBCAPCD Form 24

SOURCES:

(1) URBEMIS 2007 Version 9.2, Appendix I - Construction Equipment Emission Factors, Year 2008

(2) EMFAC 2007 Version 2.3 On-Road Emission Factors, Year 2008

(3) SCAQMD CEQA Air Quality Handbook - Table A9-8-A

NOTES:

(a) Emission factors from EMFAC 2007 Version 2.3 are in lbs/mile

(b) Emission factor is controlled in units of lbs/acre-hr with PM₁₀ fraction 0.64 and Control Efficiency of 50%.

Table B-3. Estimated daily emissions.

Emission Source	Daily Emissions (Lbs/day)				
	CO	NOx	PM10	ROG	SOx
Excavator	5.6171	22.1604	0.7665	2.0797	0.0251
Loader (4 yd ³)	3.6223	6.8788	0.3897	0.1440	0.0080
Loader (1.5 yd ³)	2.6133	4.5932	0.4200	0.1275	0.0047
Chipper/Mulcher	7.2138	13.6117	1.2295	0.3895	0.0112
Water Truck	5.8684	22.7698	0.8042	0.3722	0.0251
Dump Truck (5 tons)	0.1361	0.4458	0.0216	0.0352	0.0004
Dump Truck (30 tons)	0.2178	0.7133	0.0345	0.0563	0.0007
Dump Truck (30 tons)	10.9726	35.9316	1.7380	2.8337	0.0333
Dump Truck (30 tons)	85.6300	280.4093	13.5634	22.1143	0.2602
Road Grader	3.3824	7.7719	0.7084	0.5505	0.0065
Dozer	12.5130	23.7623	1.3461	0.4974	0.0275
Compactor	5.9828	12.6666	0.6754	0.2602	0.0128
Forklift	0.7981	1.4019	0.1384	0.0416	0.0013
Crane	4.8614	5.1600	0.1996	0.0866	0.0051
Chainsaw	0.5309	0.0005	0.0004	0.0282	0.0002
Crew Trucks	3.3051	0.3673	0.0348	0.3656	0.0043
Fugitive Dust Worst-Case Day			104.7000		
Total	153.2652	438.6443	126.7706	29.9825	0.4263

Table B-4. Estimated Proposed Action emissions.

Emission Source	Project Emissions (Lbs)				
	CO	NOx	PM10	ROG	SOx
Excavator	224.68	886.42	30.66	83.19	1.01
Loader (4 yd ³)	144.89	45.92	15.59	34.51	0.32
Loader (1.5 yd ³)	104.53	30.66	16.80	30.57	0.19
Chipper/Mulcher	144.28	45.43	24.59	46.68	0.22
Water Truck	234.74	152.00	32.17	89.22	1.01
Dump Truck (5 tons)	3.40	11.15	0.54	0.88	0.01
Dump Truck (10 tons)	5.45	17.83	0.86	1.41	0.02
Dump Truck (30 tons)	329.18	1,077.95	52.14	85.01	1.00
Dump Truck (30 tons)	2,568.90	8,412.28	406.90	663.43	7.80
Road Grader	84.56	32.43	17.71	82.46	0.16
Dozer	500.52	158.63	53.84	119.22	1.10
Compactor	149.57	52.85	16.89	38.97	0.32
Forklift	23.94	7.02	4.15	7.49	0.04
Crane	145.84	25.83	5.99	15.56	0.15
Chainsaw	6.37	0.00	0.00	2.03	0.00
Crew Trucks	132.20	14.69	1.39	14.62	0.17
Fugitive Dust			1,361.10		
Total (Lbs)	4,803.06	10,971.08	2,041.33	1,315.25	13.52
Total (Tons)	2.40	5.49	1.02	0.66	0.01

B.2 References

Jones & Stokes Associates. 2007. Software User's Guide: URBEMIS2007 for Windows Version 9.2. Emissions Estimation for Land Use Development Projects. November.

SBCAPCD. 2007. 2007 Clear Air Plan. Santa Barbara County's plan to maintain the federal 8-hour ozone standard and attain the state 1-hour ozone standard. August 2007.

APPENDIX C

Biological Resources

Appendix C. Biological Resources

Table C-1. Plant species documented within the survey area for the proposed creek restoration.

Scientific Name	Common Name	Scientific Name	Common Name
<i>Amsinckia</i> sp.	Fiddleneck	<i>Gnaphalium ramosissimum</i>	Pink everlasting
<i>Artemisia californica</i>	California sagebrush	<i>Heliotropium curassavicum</i>	Heliotrope
<i>Artemisia douglasiana</i>	Mugwort	<i>Heteromeles arbutifolia</i>	Toyon
<i>Asphodelus fistulosus</i> *	Asphodel	<i>Heterotheca grandiflora</i>	Telegraph weed
<i>Atriplex semibaccata</i> *	Australian saltbush	<i>Hirschfeldia incana</i> *	Perennial mustard
<i>Avena barbata</i> *	Slender wild oats	<i>Hordeum murinum</i> *	Foxtail barely
<i>Baccharis douglasii</i>	Marsh baccharis	<i>Juncus patens</i>	Spreading rush
<i>Baccharis pilularis</i>	Coyote brush	<i>Lathyrus latifolius</i> *	Sweet-pea
<i>Brassica nigra</i> *	Black mustard	<i>Lepidium draba</i> *	Heart-podded hoary cress
<i>Bromus diandrus</i> *	Ripgut brome	<i>Leymus condensatus</i>	Giant wild-rye
<i>Bromus hordeaceus</i> *	Soft-chess brome	<i>Leymus triticoides</i>	Beardless wild-rye
<i>Calystegia macrostegia</i>	Morning-glory	<i>Lobularia maritima</i> *	Sweet alyssum
<i>Carduus pycnocephalus</i> *	Italian thistle	<i>Lolium multiflorum</i> *	Italian ryegrass
<i>Centaurea melitensis</i> *	Tacolote	<i>Lotus scoparius</i>	Deerweed
<i>Chenopodium californicum</i>	California goosefoot	<i>Malva nicaeensis</i> *	Mallow
<i>Cirsium vulgare</i> *	Bull thistle	<i>Marah fabaceus</i>	Manroot
<i>Conium maculatum</i> *	Poison hemlock	<i>Marrubium vulgare</i> *	Horehound
<i>Conyza canadensis</i> *	Common horseweed	<i>Medicago polymorpha</i> *	Bur-clover
<i>Croton californicus</i>	Croton	<i>Melilotus</i> sp.*	Sweet-clover
<i>Cynodon dactylon</i> *	Bermuda grass	<i>Mimulus aurantiacus</i>	Sticky monkeyflower
<i>Deinandra increscens</i>	Tarplant	<i>Nicotiana glauca</i> *	Tree tobacco
<i>Digitaria sanguinalis</i> *	Crabgrass	<i>Phalaris minor</i> *	Phalaris
<i>Distichlis spicata</i>	Salt grass	<i>Picris echioides</i> *	Bristly ox-tongue
<i>Ehrharta calycina</i> *	Veldt grass	<i>Plantago coronopus</i> *	Cutleaf plantain
<i>Leymus condensatus</i>	Giant wildrye	<i>Plantago lanceolata</i> *	English plantain
<i>Epilobium ciliatum</i>	Willow-herb	<i>Quercus agrifolia</i>	Coast live oak
<i>Ericameria ericoides</i>	Mock heather	<i>Raphanus sativus</i> *	Wild radish
<i>Eriogonum parvifolium</i>	Seacliff buckwheat	<i>Rorippa nasturtium-aquaticum</i>	Watercress
<i>Erodium botrys</i> *	Storkbill filaree	<i>Rosa californica</i>	California rose
<i>Erodium cicutarium</i> *	Redstem filaree	<i>Rubus ursinus</i>	California blackberry
<i>Foeniculum vulgare</i> *	Fennel	<i>Rumex acetosella</i> *	Sheep sorrel
<i>Galium aparine</i>	Common bedstraw	<i>Rumex crispus</i> *	Curly dock
<i>Galium porrigens</i>	Climbing bedstraw	<i>Rumex salicifolius</i>	Willow dock
<i>Gnaphalium stramineum</i>	Annual everlasting	<i>Salix laevigata</i>	Red willow
<i>Gnaphalium californicum</i>	California everlasting	<i>Salix lasiolepis</i>	Arroyo willow
<i>Gnaphalium luteo-album</i> *	Cudweed	<i>Salsola tragus</i> *	Russian thistle

Scientific Name	Common Name	Scientific Name	Common Name
<i>Sambucus mexicana</i>	Blue elderberry	<i>Sonchus oleraceus</i> *	Common sow-thistle
<i>Sanicula crassicaulis</i>	Common sanicle	<i>Spergularia bocconeii</i> *	Sand-spurry
<i>Scirpus californicus</i>	California tule	<i>Toxicodendron diversilobum</i>	Poison oak
<i>Scrophularia californica</i>	California figwort	<i>Typha</i> sp.	Cattail
<i>Silybum marianum</i> *	milk thistle	<i>Urtica dioica</i>	Stinging nettle
<i>Solanum douglasii</i>	Black nightshade	<i>Urtica urens</i> *	Dwarf nettle
<i>Solanum xanti</i>	Purple nightshade	<i>Verbena lasiostachys</i>	Vervain
<i>Sonchus asper</i> *	Prickly sow-thistle	<i>Vulpia myuros</i> *	Rattail fescue

* Non-native species

SOURCE: Plant surveys were performed by MSRS in February 2008.

Table C-2. Wildlife species within the survey area for the proposed creek restoration.

Scientific Name	Common Name	Occurrence	Status ^(*)
Fish			
<i>Gasterosteus aculeatus williamsoni</i>	Unarmored threespine stickleback	Observed	FE, CE
<i>Eucyclogobius newberryi</i>	Tidewater goby	Observed	FE
Amphibians			
<i>Ensatina eschscholtzii</i>	Monterey ensatina	Potential	
<i>Aneides lugubris</i>	Arboreal salamander	Potential	
<i>Batrachoseps nigriventris</i>	Black-bellied slender salamander	Potential	
<i>Spea hammondi</i>	Western spadefoot	Potential	CSC
<i>Bufo boreas</i>	Western toad	Potential	
<i>Hyla regilla</i>	Pacific treefrog	Observed	
<i>Rana catesbeiana</i>	Bullfrog	Observed	
<i>Rana draytonii</i>	California red-legged frog	Observed	FT, CSC
Reptiles			
<i>Actinemys marmorata</i>	Western pond turtle	Observed	CSC
<i>Sceloporus occidentalis</i>	Western fence lizard	Observed	
<i>Uta stansburiana</i>	Common side-blotched lizard	Potential	
<i>Phrynosoma coronatum</i>	Coast horned lizard	Potential	CSC
<i>Eumeces skiltonianus</i>	Western skink	Potential	
<i>Anniella pulchra</i>	California legless lizard	Potential	CSC
<i>Elgaria multicarinata</i>	Southern alligator lizard	Observed	
<i>Coluber constrictor</i>	Racer	Potential	
<i>Masticophis lateralis</i>	Chaparral whipsnake	Potential	
<i>Lampropeltis getula</i>	California kingsnake	Observed	
<i>Pituophis catenifer</i>	San Diego gophersnake	Observed	
<i>Thamnophis sirtalis</i>	Common gartersnake	Observed	
<i>Thamnophis elegans</i>	Western terrestrial gartersnake	Potential	
<i>Crotalus helleri</i>	Southern Pacific rattlesnake	Observed	
Birds			
<i>Butorides virescens</i>	Green heron	Observed	
<i>Cathartes aura</i>	Turkey vulture	Observed	
<i>Accipiter cooperii</i>	Cooper's hawk	Observed	
<i>Buteo jamaicensis</i>	Red-tailed hawk	Observed	
<i>Falco sparverius</i>	American kestrel	Observed	
<i>Callipepla californica</i>	California quail	Observed	
<i>Charadrius vociferus</i>	Killdeer	Observed	
<i>Zenaida macroura</i>	Mourning dove	Observed	
<i>Geococcyx californianus</i>	Greater roadrunner	Observed	
<i>Tyto alba</i>	Barn owl	Observed	

Scientific Name	Common Name	Occurrence	Status ^(*)
<i>Calypte anna</i>	Anna's hummingbird	Observed	
<i>Selasphorus sasin</i>	Allen's hummingbird	Observed	
<i>Colaptes auratus</i>	Northern flicker	Observed	
<i>Picoides nuttallii</i>	Nuttall's woodpecker	Observed	
<i>Picoides pubescens</i>	Downy woodpecker	Observed	
<i>Picoides villosus</i>	Hairy woodpecker	Observed	
<i>Contopus sordidulus</i>	Western wood-pewee	Observed	
<i>Empidonax difficilis</i>	Pacific-slope flycatcher	Observed	
<i>Sayornis nigricans</i>	Black phoebe	Observed	
<i>Myiarchus cinerascens</i>	Ash-throated flycatcher	Observed	
<i>Vireo huttoni</i>	Hutton's vireo	Observed	
<i>Vireo gilvus</i>	Warbling vireo	Observed	
<i>Aphelocoma californica</i>	Western scrub-jay	Observed	
<i>Corvus brachyrhynchos</i>	American crow	Observed	
<i>Corvus corax</i>	Common raven	Observed	
<i>Tachycineta bicolor</i>	Tree swallow	Observed	
<i>Petrochelidon pyrrhonota</i>	Cliff swallow	Observed	
<i>Stelgidopteryx serripennis</i>	Northern rough-winged swallow	Observed	
<i>Hirundo rustica</i>	Barn swallow	Observed	
<i>Chamaea fasciata</i>	Wrentit	Observed	
<i>Baeolophus inornatus</i>	Oak titmouse	Observed	
<i>Poecile rufescens</i>	Chestnut-backed chickadee	Observed	
<i>Psaltiriparus minimus</i>	Bushtit	Observed	
<i>Troglodytes aedon</i>	House wren	Observed	
<i>Thryomanes bewickii</i>	Bewick's wren	Observed	
<i>Sialia mexicana</i>	Western bluebird	Observed	
<i>Catharus ustulatus</i>	Swainson's thrush	Observed	
<i>Catharus guttatus</i>	Hermit thrush	Observed	
<i>Turdus migratorius</i>	American robin	Observed	
<i>Toxostoma redivivum</i>	California thrasher	Observed	
<i>Sturnus vulgaris</i>	European starling	Observed	
<i>Vermivora celata</i>	Orange-crowned warbler	Observed	
<i>Dendroica coronata</i>	Yellow-rumped warbler	Observed	
<i>Dendroica petechia</i>	Yellow warbler	Observed	CSC
<i>Wilsonia pusilla</i>	Wilson's warbler	Observed	
<i>Geothlypis trichas</i>	Common yellowthroat	Observed	
<i>Icteria virens</i>	Yellow-breasted chat	Observed	CSC
<i>Pipilo crissalis</i>	California towhee	Observed	
<i>Pipilo maculatus</i>	Spotted towhee	Observed	
<i>Chondestes grammacus</i>	Lark sparrow	Observed	

Scientific Name	Common Name	Occurrence	Status ^(*)
<i>Ammodramus savannarum</i>	Grasshopper sparrow	Observed	
<i>Melospiza melodia</i>	Song sparrow	Observed	
<i>Zonotrichia leucophrys</i>	White-crowned sparrow	Observed	
<i>Pheucticus melanocephalus</i>	Black-headed grosbeak	Observed	
<i>Guiraca caerulea</i>	Blue grosbeak	Observed	
<i>Passerina amoena</i>	Lazuli bunting	Observed	
<i>Sturnella neglecta</i>	Western meadowlark	Observed	
<i>Agelaius phoeniceus</i>	Red-winged blackbird	Observed	
<i>Molothrus ater</i>	Brown-headed cowbird	Observed	
<i>Icterus bullockii</i>	Bullock's oriole	Observed	
<i>Carpodacus purpureus</i>	Purple finch	Observed	
<i>Carpodacus mexicanus</i>	House finch	Observed	
<i>Carduelis tristis</i>	American goldfinch	Observed	
<i>Carduelis psaltria</i>	Lesser goldfinch	Observed	
Mammals			
<i>Didelphis virginiana</i>	Virginia opossum	Observed	
<i>Sorex trowbridgii</i>	Trowbridge's shrew	Potential	
<i>Sorex ornatus</i>	Ornate shrew	Potential	
<i>Scapanus latimanus</i>	Broad-footed mole	Observed	
<i>Myotis yumanensis</i>	Yuma myotis	Potential	
<i>Myotis evotis</i>	Long-eared myotis	Potential	
<i>Myotis thysanodes</i>	Fringed myotis	Potential	
<i>Myotis volans</i>	Long-legged myotis	Potential	
<i>Myotis californicus</i>	California myotis	Potential	
<i>Myotis ciliolabrum</i>	Small-footed myotis	Potential	
<i>Lasionycteris noctivagans</i>	Silver-haired bat	Potential	
<i>Pipistrellus hesperus</i>	Western pipistrelle	Potential	
<i>Eptesicus fuscus</i>	Big brown bat	Potential	
<i>Lasiurus blossevillii</i>	Western red bat	Potential	CSC
<i>Lasiurus cinereus</i>	Hoary bat	Potential	CSC
<i>Corynorhinus townsendii</i>	Townsend's big-eared bat	Potential	CSC
<i>Antrozous pallidus</i>	Pallid bat	Potential	CSC
<i>Tadarida brasiliensis</i>	Mexican free-tailed bat	Potential	
<i>Eumops perotis</i>	Western mastiff bat	Potential	CSC
<i>Sylvilagus bachmani</i>	Brush rabbit	Observed	
<i>Lepus californicus</i>	Black-tailed jackrabbit	Potential	
<i>Spermophilus beecheyi</i>	California ground squirrel	Observed	
<i>Thomomys bottae</i>	Botta's pocket gopher	Observed	
<i>Dipodomys agilis</i>	Pacific kangaroo rat	Potential	
<i>Dipodomys heermanni</i>	Heermann's kangaroo rat	Potential	

Scientific Name	Common Name	Occurrence	Status ^(*)
<i>Chaetodipus californicus</i>	California pocket mouse	Potential	
<i>Castor canadensis</i>	American beaver	Observed	
<i>Microtus californicus</i>	California vole	Potential	
<i>Peromyscus maniculatus</i>	Deer mouse	Potential	
<i>Peromyscus boylii</i>	Brush mouse	Potential	
<i>Peromyscus californicus</i>	California mouse	Potential	
<i>Reithrodontomys megalotis</i>	Harvest mouse	Potential	
<i>Neotoma fuscipes</i>	Dusky-footed woodrat	Observed	
<i>Urocyon cinereoargenteus</i>	Gray fox	Potential	
<i>Canis latrans</i>	Coyote	Observed	
<i>Felis concolor</i>	Mountain lion	Observed	
<i>Procyon lotor</i>	Raccoon	Observed	
<i>Mustela frenata</i>	Long-tailed weasel	Potential	
<i>Spilogale gracilis</i>	Western spotted skunk	Observed	
<i>Mephitis mephitis</i>	Striped skunk	Observed	
<i>Lynx rufus</i>	Bobcat	Potential	
<i>Sus scrofa</i>	Wild pig	Potential	
<i>Odocoileus hemionus</i>	Mule deer	Observed	

FE= Federally Endangered FT= Federally Threatened CE= California Endangered Species
CSC= California Species of Concern

SOURCES: Wildlife surveys were performed by MSRS in 2008 within the proposed restoration area. Sources used to determine potential occurrence include UCSB unpublished avian point count data from 2002 and 2004, and MSRS unpublished data from Barka Slough in 2004 and 2005.

APPENDIX D

Wetland Delineation

Assessment of Wetland Habitats at the San Antonio Creek Restoration Site

Vandenberg Air Force Base, California

April 2008

Prepared for

30th Space Wing Environmental Flight
30 CEV/CEV
1028 Iceland Ave.
Vandenberg AFB, CA 93437-6010

Prepared by

ManTech SRS Technologies, Inc.
Mission Services Division
102 East Ocean Avenue
Lompoc, CA 93436

Table of Contents

1.0	Introduction.....	1
2.0	Methods.....	3
2.1	Vegetation.....	3
2.2	Hydrology.....	4
2.3	Soils	4
2.4	Waters of the United States	5
2.5	Field Surveys and Mapping.....	5
3.0	Results	10
3.1	Vegetation.....	10
3.2	Hydrology.....	11
3.3	Soil.....	12
3.4	Waters of the United States	13
3.5	Field Surveys and Mapping.....	13
4.0	Conclusion.....	19
5.0	Bibliography.....	21

Appendix 1: Wetland Delineation Forms

Appendix 2: Plant Species Observed

List of Figures

Figure 1. Rip-rap installed at the San Antonio Road West creek bend during the 1998 emergency action	1
Figure 2. <i>Typha</i> sp. and <i>Rorippa nasturtium-aquaticum</i> (water cress), recolonizing creek bank. Inset: <i>Typha</i> sp. resprouting from exposed rhizome.	11
Figure 3. Vegetation bent from previous flow events provides evidence of drainage patterns in wetlands.	11
Figure 4. The dark upper layer visible on this eroding cliff face is a silty clay loam reflective of relic hydric conditions.....	12
Figure 5. Shelving on the bank (left) and sediment deposits (right) were two features used to determine the OHWM.....	13

List of Maps

Map 1. Location of proposed San Antonio Creek restoration project area 2

Map 2. Wetland Delineation Locations 6

Map 3. Wetland Delineation Locations 7

Map 4. Wetland Delineation Locations 8

Map 5. Wetland Delineation Locations 9

Map 6. Vegetation Types 19

Map 7. Waters of the United States 21

List of Tables

Table 1: Vegetation Strata 3

Table 2: Wetland Indicator Status..... 4

Table 3: Vegetation types within the project area 10

Acronyms and Abbreviations

AFB	Air Force Base
H	Herb stratum
FAC	Facultative Plant
FACU	Facultative Upland Plant
FACW	Facultative Wetland Plant
MSRS	ManTech SRS Technologies
OBL	Obligate Wetland Plant
OHWM	Ordinary High Watermark
S	Sapling/Shrub stratum
T	Tree stratum
UPL	Obligate Upland Plant
USACE	United States Army Corps of Engineers
V	Woody vine stratum
VAFB	Vandenberg Air Force Base
WIS	Wetland Indicator Status

[This page intentionally left blank.]

1.0 Introduction

San Antonio Creek flows through the northern portion of Vandenberg Air Force Base (VAFB). North of San Antonio Road West, the creek has experienced down cutting and scour that threaten the integrity of San Antonio Road West and the Lee Road Utility Bridge. This erosion necessitated an emergency repair in 1998 which involved the installation of extensive rip-rap embankments at the Lee Road Utility Bridge crossing and at the San Antonio Road West Creek Bend. A complete description of emergency repairs undertaken in 1998 is included in the Environmental Assessment for the San Antonio Creek Restoration Project (VAFB *In Progress*).

The 1998 emergency repair does not constitute a permanent fix to erosion issues threatening San Antonio Road West and the Lee Road Utility Bridge. Therefore, VAFB proposes to remediate the extensive damage to the banks and stream channel in the area between Barka Slough and the downstream crossing of San Antonio Road West by implementing restoration actions in San Antonio Creek. The goals of the proposed project are to restore hydrologic function, enhance stream stability, minimize the potential for further erosion, protect several creek embankments, and promote the return of proper channel function. A complete description of proposed restoration activities is included in the Environmental Assessment for the San Antonio Creek Restoration Project (VAFB *In Progress*). Map 1 illustrates the location of the proposed project area.

To quantify wetland habitat likely to be impacted by the proposed restoration, a wetland delineation was conducted within the 105 acre proposed project area in February through April 2008. ManTech SRS Technologies, Inc. (MSRS) biologists experienced with federal wetland delineation methodology performed the wetland delineation.

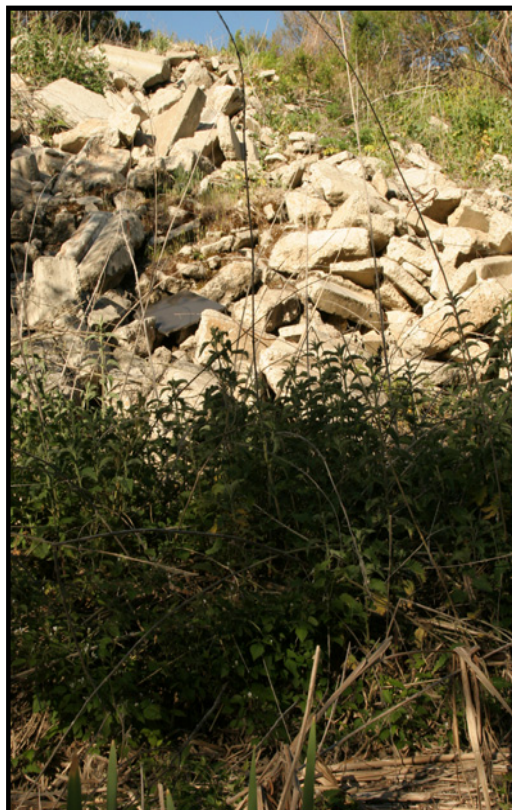
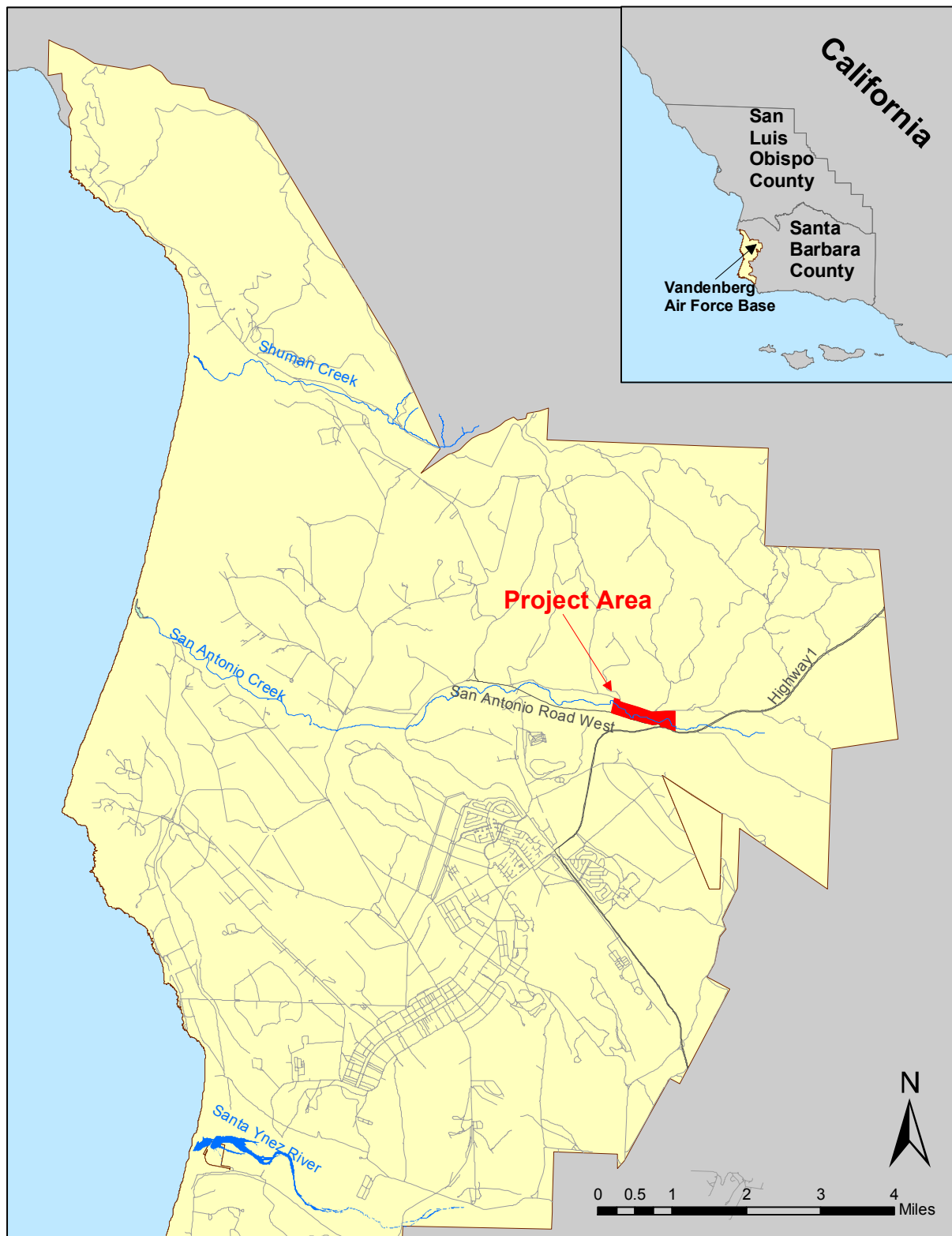


Figure 1. Rip-rap installed at the San Antonio Road West creek bend during the 1998 emergency action.



Map 1. Location of proposed San Antonio Creek restoration project area.

2.0 Methods

Wetland surveys were conducted within the project area for the proposed San Antonio Creek restoration from February through April 2008. In addition to field surveys, 2004 and 2005 aerial imagery of the project area, and the Soil Survey of Northern Santa Barbara Area, California (United States Department of Agriculture [USDA] 1972) were consulted. Wetlands were delineated in accordance with United States Army Corps of Engineers (USACE) Wetland Delineation Manual (USACE 1987, 2006). Potential wetlands were evaluated for the presence of hydric vegetation, wetland hydrology and hydric soils.

2.1 Vegetation

Hydric vegetation is defined as having more than fifty percent of the dominant species able to grow, effectively compete, reproduce, and/or persist in anaerobic soil conditions. When classifying vegetation, plants are grouped into four strata depending on height, growth habit and morphology (Table 1; Wetland Training Institute, Inc. [WTI] 1995).

Table 1: Vegetation Strata.

Code	Stratum	Description
H	Herb	All non-woody plants, and woody plants less than 3.2 feet in height
S	Sapling/Shrub	Woody plants greater than or equal to 3.2 feet in height, but less than 3.0 inch diameter at breast height
T	Tree	Woody plants greater than or equal to 3 inches at breast height, regardless of height
V	Woody vine	Woody climbing plants greater than or equal to 3.2 feet in height

Dominant species were determined for each strata using the 50/20 rule. Plants were evaluated in order of descending abundance until species comprising at least fifty percent of the vegetation in a particular stratum, as determined by relative cover, had been accounted for. Any additional species occupying at least twenty percent of the stratum were also listed as dominants. Relative cover was determined by visual estimation.

To determine if vegetation present was hydric, the wetland indicator status (WIS) for dominant species was defined based on assignments from the National List of Vascular Plant Species that Occur in Wetlands (United States Fish and Wildlife Service [USFWS] 1997), which places plants in one of five categories (Table 2).

The threshold for hydrophytic vegetation is met when fifty percent or more of the dominant species are rated facultative plants (FAC) or wetter. In border line cases, such as those where all of the dominants were rated FAC or drier, FAC-Neutral Test results were used to clarify status of the vegetation. For a FAC-Neutral test the ratio of dominants rated FACW- or wetter and dominants rated FACU+ or drier is calculated. Ratios equaling one or greater constitute positive results and support the designation of vegetation as hydric.

Table 2: Wetland Indicator Status

Code	WIS	Description
OBL	Obligate Wetland	Plants that almost always occur (estimated probability 99%) in wetlands under natural conditions, but may also occur rarely (estimated probability 1%) in non-wetlands
FACW	Facultative Wetland	Plants that usually occur (estimated probability 67% to 99%) in wetlands, but also occur (estimated probability 1% to 33%) in non-wetlands.
FAC	Facultative	Plants with a similar likelihood (estimated probability 33% to 67%) of occurring in both wetlands and non-wetlands.
FACU	Facultative Upland	Plants that sometimes occur (estimated probability 1% to 33%) in wetlands, but occur more often (estimated probability 67% to 99%) in non-wetlands.
UPL	Obligate Upland	Those plants that rarely (estimated probability 1%) occur in wetlands, but occur almost always (estimated probability 99%) in non-wetlands under natural conditions.

*Modifiers, + or – , further characterize WIS ranks with + plants favoring the wetter end of the spectrum and – favoring the drier end of each ranking category. Plants not assigned a WIS are assumed UPL unless there is supporting documentation available to the contrary.

2.2 Hydrology

Areas with wetland hydrology are inundated either permanently or periodically at mean water depths less than or equal to 6.6 feet, or the soil is saturated to the surface at some time during the growing season of the prevalent vegetation. Positive findings for wetland hydrology require the finding of at least one primary indicator or two secondary indicators (WTI 1995).

Plots were subject to visual inspection for indicators of hydrology such as inundation, water marks, drift lines, sediment deposits, drainage patterns in wetlands, and water stained leaves. Pits were excavated with a 16 inch bladed drain spade to a depth of at least 12 inches to characterize depth of free water, depth of saturated soil, and determine the presence of oxidized rhizospheres surrounding live roots. FAC-Neutral test results were also considered when making a determination of wetland hydrology.

2.3 Soils

Hydric soils possess characteristics that are associated with reducing soil conditions indicative of saturation, flooding, or ponding, for sufficient duration during the growing season to develop anaerobic conditions in the upper part (WTI 1995). To determine if reducing conditions were present, soil profiles were examined.

Test pits were excavated and an intact soil core section, at least 10 inches in height spanning the vertical range of the pit, was removed from each hole. Soil color and texture were characterized from this sample. Soil color was determined by the comparison of moist samples to the color plates in the Munsell Soil Color Charts (2000). Texture was evaluated by touch, following procedures adapted from Steve Thien (WTI 2003). In cases

where soil was too dry for color and textural evaluations, water was added. The vertical span and distribution of various soil layers, as determined by color and textural differences, was measured and noted.

2.4 Waters of the United States

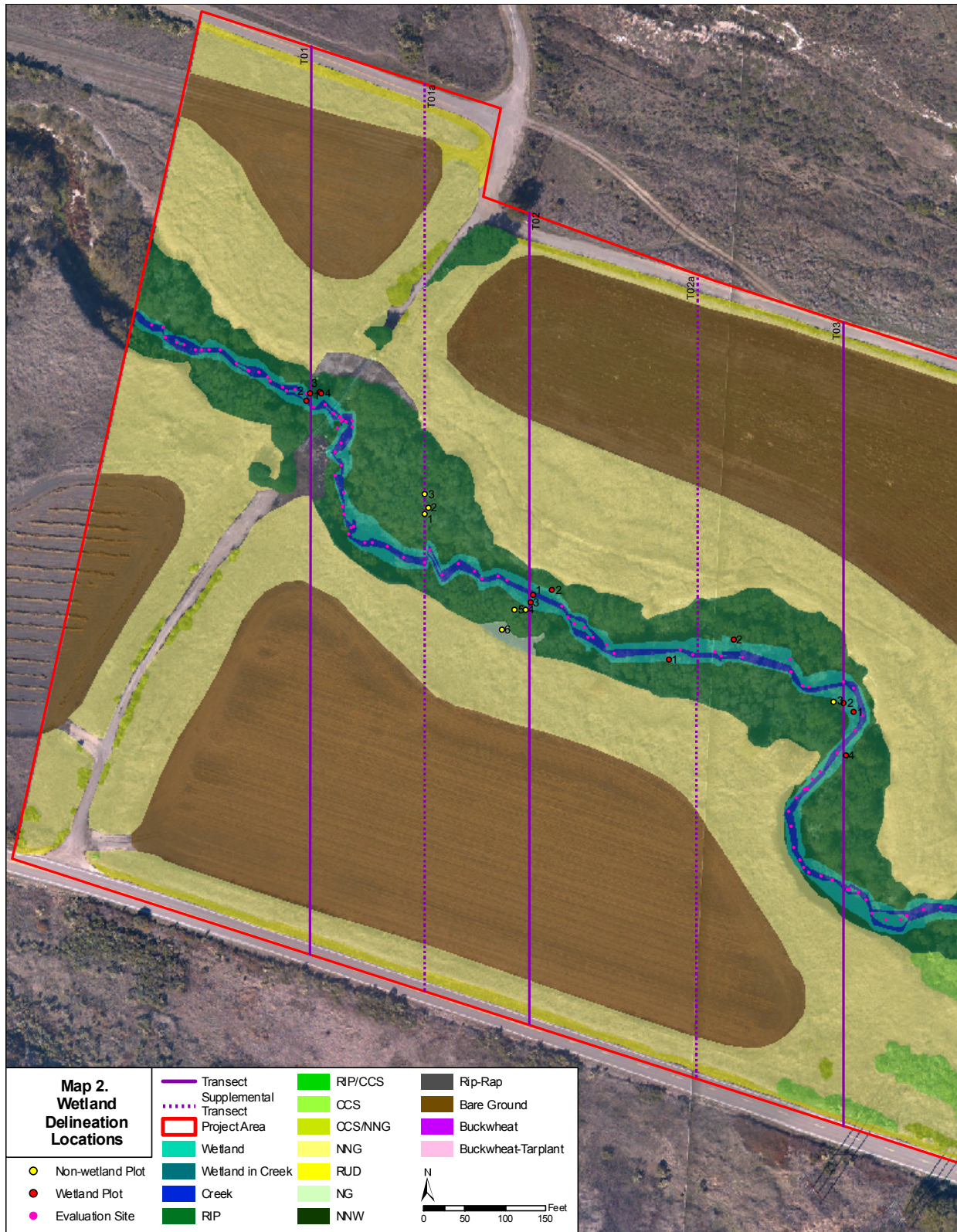
The limits of jurisdictional waters of the United States were determined using the Ordinary High Watermark (OHWM) as indicated by drift lines, waterstaining, and shelving present on the bank. Wetland extent adjacent to the creek, and areas encompassed by the creek were also measured.

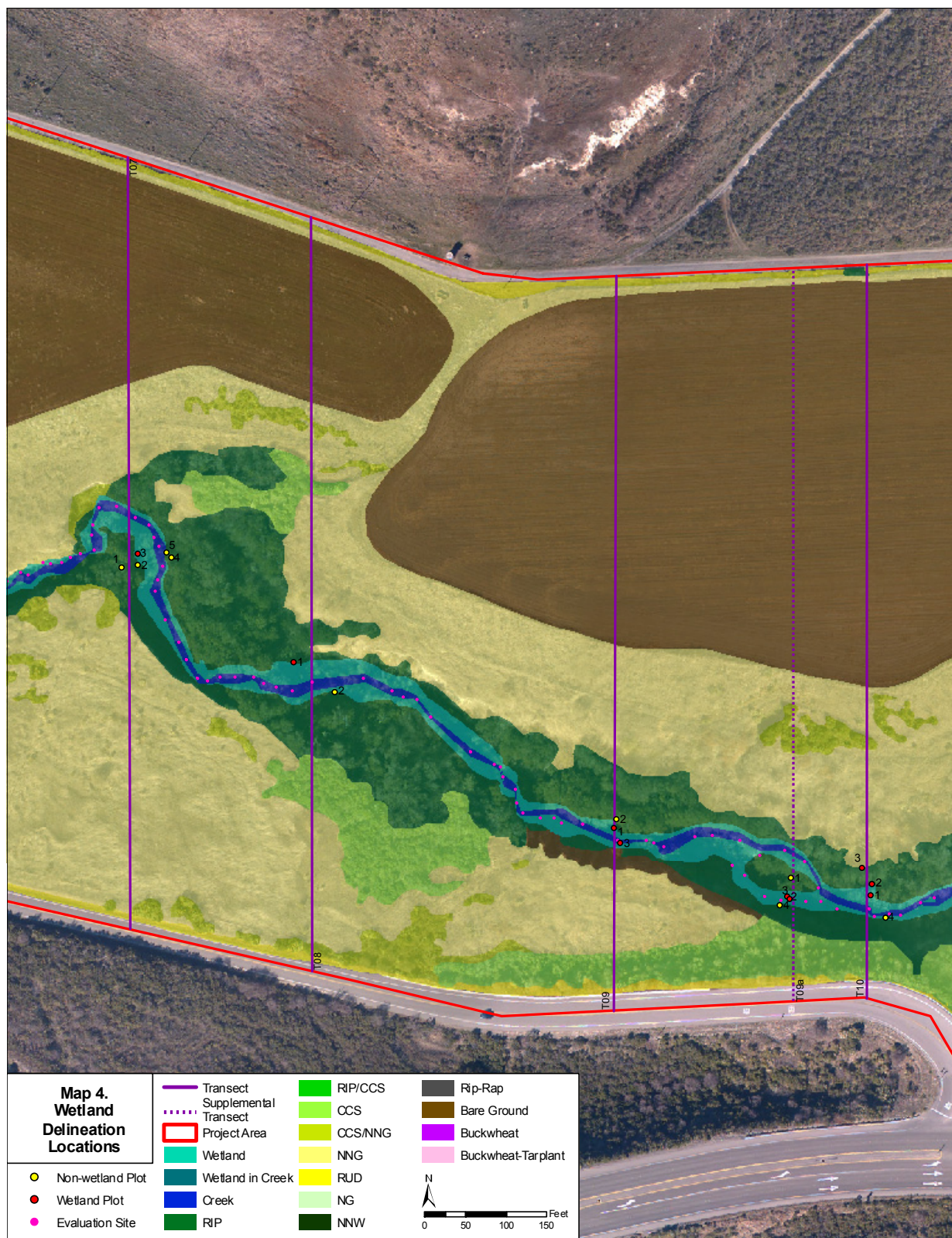
2.5 Field Surveys and Mapping

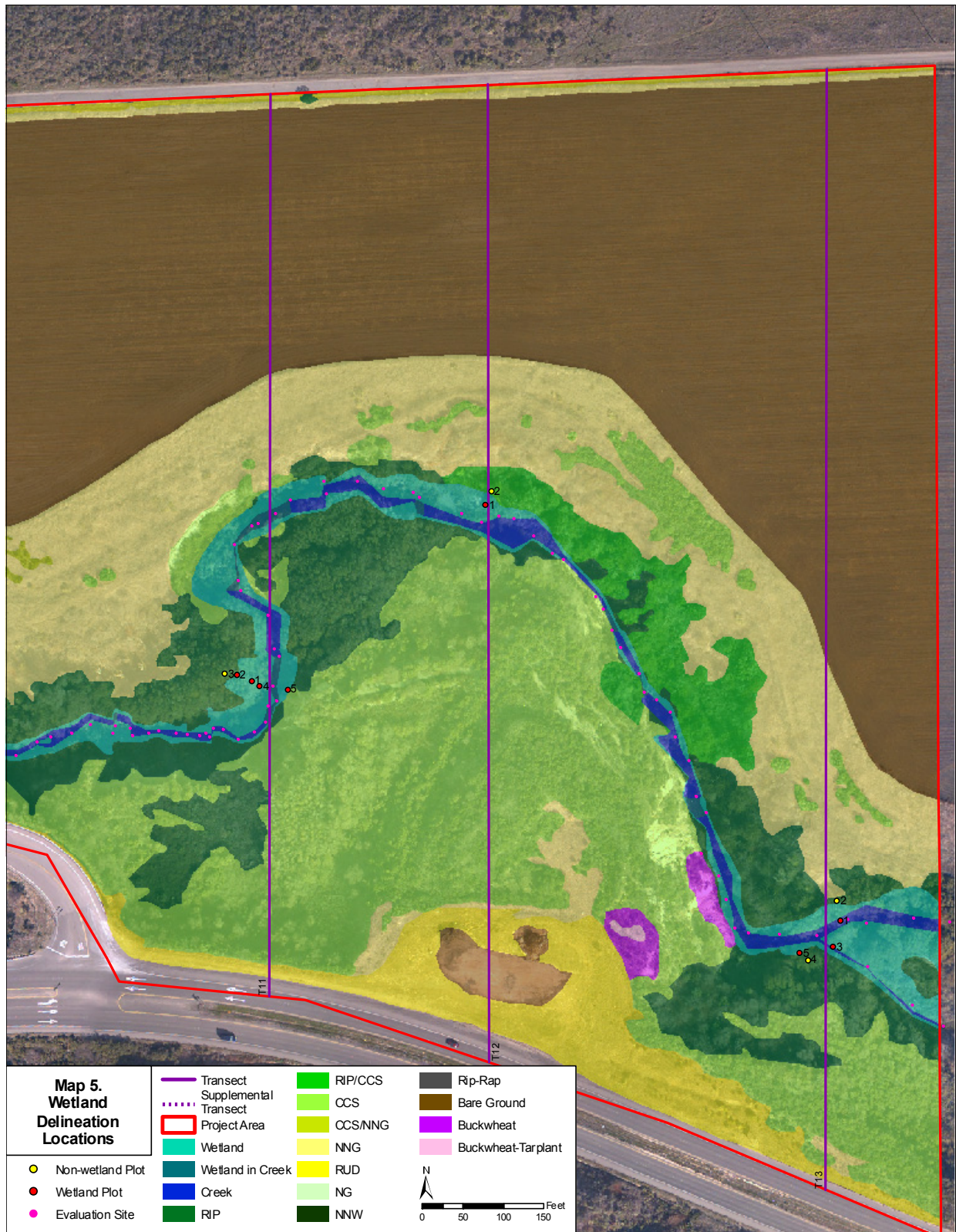
Thirteen transects and four supplemental transects were established within the proposed project area. Transects were oriented in a north-south direction, perpendicular to the path of the creek, every 300 to 400 feet, with exact placement depending on site conditions. Supplemental transects were established in intervening areas where additional plots were needed to determine wetland boundaries.

Representative plots were chosen along each transect within different vegetation types, growing conditions and/or at wetland-upland interface areas. Plots had a 30-foot radius where conditions permitted. In cases where habitats and vegetation types were small or shaped irregularly, the plots were demarcated by boundaries of vegetation types. USACE wetland delineation forms characterizing vegetation, hydrology and soils were completed for each plot. The locations of soil test pits were marked with pin flags and mapped with Global Positioning System units (Trimble Geo XT, Trimble Geo XM, or Garmin IV).

Once indicators of wetland boundaries were determined, additional evaluation sites were established along the creek. At each evaluation site, creek width, wetland width, and the distance to the OHWM were estimated at a given heading (north, south, east, or west). Evaluation sites were established at changes in creek direction and width, wetland width, and OHWM distance. Site locations were mapped in the field with Trimble Geo XT. Estimated distances were plotted using ArcMap 9.2, and used to generate maps of wetlands, vegetation types, and the boundaries of Waters of the United States within the project area. Maps 2, 3, 4, and 5 illustrate the locations of transects, plots and evaluation sites.







3.0 Results

3.1 Vegetation

Vegetation within the incised banks is composed primarily of hydric species and vegetation types (Table 3). Hydric vegetation types within the project area include willow riparian (RIP) and freshwater marsh (FWM). Willow riparian is the most extensive vegetation type within the incised creek channel. *Salix lasiolepis*, arroyo willow and *Salix laevigata*, red willow are the dominant tree species, with *Salix laevigata* predominating in low lying wetter areas. In areas with relatively open canopies understory vegetation is well developed and dominated by vining species such as *Rubus ursinus*, blackberry, and non-native herbaceous species such as *Lepidium draba*, hoary cress, and *Conium maculatum*, poison hemlock. In areas with dense canopy cover, little understory vegetation is present. Most willow riparian vegetation had no evidence of recent disturbance from water flow.

Table 3: Vegetation types within the project area

Code	Vegetation Type	Description	Acreage
BAR	Bare ground	Unvegetated slopes and disked agricultural fields	41.28
CCS	Central coast scrub	Shrub vegetation type dominated by <i>Baccharis pilularis</i> and <i>Artemisia californica</i>	9.08
CCS/NNG	Mixed central coast scrub non-native grassland	Mixed shrub and herbaceous vegetation dominated by <i>Baccharis pilularis</i> , <i>Brassica</i> spp. and <i>Conium maculatum</i>	2.28
NG	Native grassland	Herbaceous vegetation dominated by native grasses (<i>Leymus condensatus</i>) and herbs (<i>Urtica dioica</i>)	0.06
NNG	Non-native grassland	Non-native herbaceous vegetation dominated by <i>Brassica</i> spp., <i>Conium maculatum</i> , <i>Cardaria draba</i> , <i>Bromus</i> spp. or <i>Avena barbata</i>	29.51
NNW	Non-native woodland	Vegetation dominated by non-native trees, <i>Nicotiana glauca</i>	0.09
RIP	Willow riparian	Riparian vegetation dominated by <i>Salix lasiolepis</i> and <i>Salix laevigata</i> .	12.01
RIP/CCS	Mixed willow riparian central coast scrub	Mixed tree and shrub vegetation dominated by <i>Salix lasiolepis</i> and <i>Baccharis pilularis</i>	0.81
RIP-RAP	Rip-rap	Sparsely vegetated areas of mixed rocks, boulders and concrete installed for slope stabilization	0.21
RUD	Ruderal	Highly disturbed herbaceous vegetation, typically occurring on road shoulders or areas subjected to mowing	2.86
FWM	Fresh water marsh	Wetland vegetation dominated by <i>Typha</i> spp., <i>Scirpus</i> spp., or <i>Urtica dioica</i> . Riparian overstory may also be present.	3.18
Creek	Creek	Open water, may support fresh water marsh vegetations as season progresses	1.29



Figure 2. *Typha* sp. and *Rorippa nasturtium-aquaticum*, watercress, recolonizing creek bank. Inset: *Typha* sp. resprouting from exposed rhizome.

Fresh water marsh occurs primarily as an understory to the willow riparian in and along the creek, on low lying benches, and along ephemeral and secondary channels. Fresh water marsh grows in areas subject to scouring during winter high flows. *Typha* spp. (cattails), and *Scirpus* spp. (rushes) dominate in and along the creek, and ephemeral and secondary channels. Species such as *Urtica dioica* (stinging nettle) and *Baccharis douglasii* (marsh Baccharis) dominate on low lying benches. Much of this vegetation was washed away during the 2007-2008 winter rains. In the course of the present survey, it appeared in an early successional state, dominated by seedlings or resprouts from buried root material, with bare ground predominating. Due to the early successional state of this vegetation type, it is likely to become

more extensively distributed than mapped during the field surveys, especially within and adjacent to the creek itself.

Upland vegetation types such as central coast scrub (CCS) dominated by *Baccharis pilularis* (coyote brush), non-native grassland (NNG) dominated by *Brassica* spp. (mustards), *Cardaria draba* (hoary cress), and *Conium maculatum* (poison hemlock), are present in non-wetland areas. A complete list of plant species observed and their WIS is included in Appendix 2. Map 6 illustrates the distribution of vegetation types within the project area.

3.2 Hydrology

Wetland hydrology was the most conserved wetland parameter. Drift lines, and drainage patterns in wetlands were the most common and extensive primary indicators of wetland hydrology. Along the main creek channel where steep banks are present, pronounced shelving is also present indicative of flow. In areas where the creek is bordered by rip-rap or shear cliffs, water staining is the primary indicator of wetland hydrology.



Figure 3. Vegetation bent from previous flow events provides evidence of drainage patterns in wetlands.

Saturation in the upper 12 inches was restricted to areas immediately adjacent to the main channel, within ephemeral feeder channels, and within hillside seeps.

3.3 Soil

In many of the transects upstream of transect 7 (see Map 4), soil rather than hydrology is the most conserved wetland parameter. The incised channel itself consists of gullied land, where the soil profile has been largely destroyed by the down cutting of the creek (USDA 1972). Areas of soil from adjacent upland areas are present as well as sediments deposited by the waters of San Antonio Creek.

Dark Agueda silty clay loam, and Salinas silty clay loams, predominate in much of the upland areas bordering the project area. These soils were formed under conditions of poor drainage. These areas are now drained and the color reflects relic rather than present hydric conditions (USDA 1972). These soils are carried into the creek channel through erosion, landslides, and run-off, where they accumulate on benches within the incised channel supporting riparian vegetation. In such areas, hydrologic indicators are necessary to determine whether the soils are reflective of past or present conditions.

Indicator A5, stratified layers, (USDA 2006) is present in side channels and on low shelves. These areas appear to experience regular flows during the rainy season, which deposit fresh sediment on top of vegetation and detritus accumulated over the previous growing season, creating a layered appearance to the profile.

Gleys are primarily restricted to areas immediately adjacent to and within active channels. These areas appear to experience reducing conditions due to saturation throughout the growing season. A sulfidic odor originating from buried decaying vegetation accompanies most gleyed profiles. In areas that are only saturated for a portion of the growing season, low chroma colors predominate, but gleys are absent.

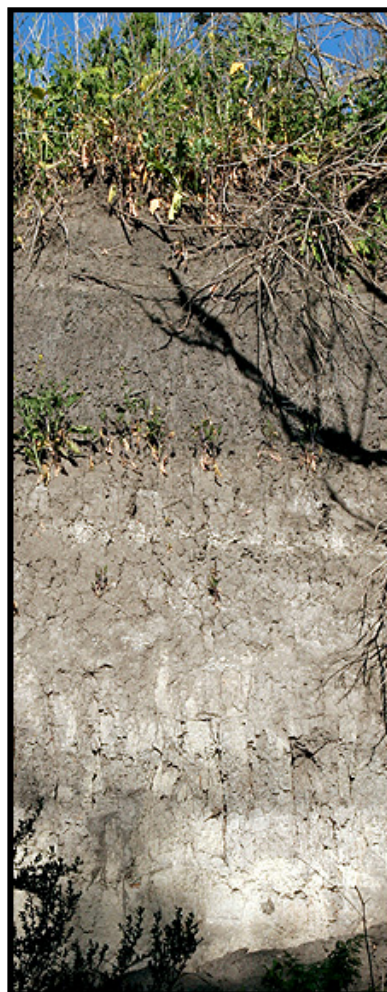


Figure 4. The dark upper layer visible on this eroding cliff face is a silty clay loam reflective of relic hydric conditions

3.4 Waters of the United States

The boundaries of Waters of the United States include areas encompassed by the OHWM of San Antonio Creek, wetlands adjacent to the San Antonio Creek channel, and areas bound by the San Antonio Creek channel. Near average rainfall levels in the 2007-2008 rainy season indicate that the OHWM established during that rainy season is likely reflective of normal circumstances. A total of 4.75 acres within the project area constitute Waters of the United States. Map 7 illustrates the extent of the Waters of the United States within the project area.

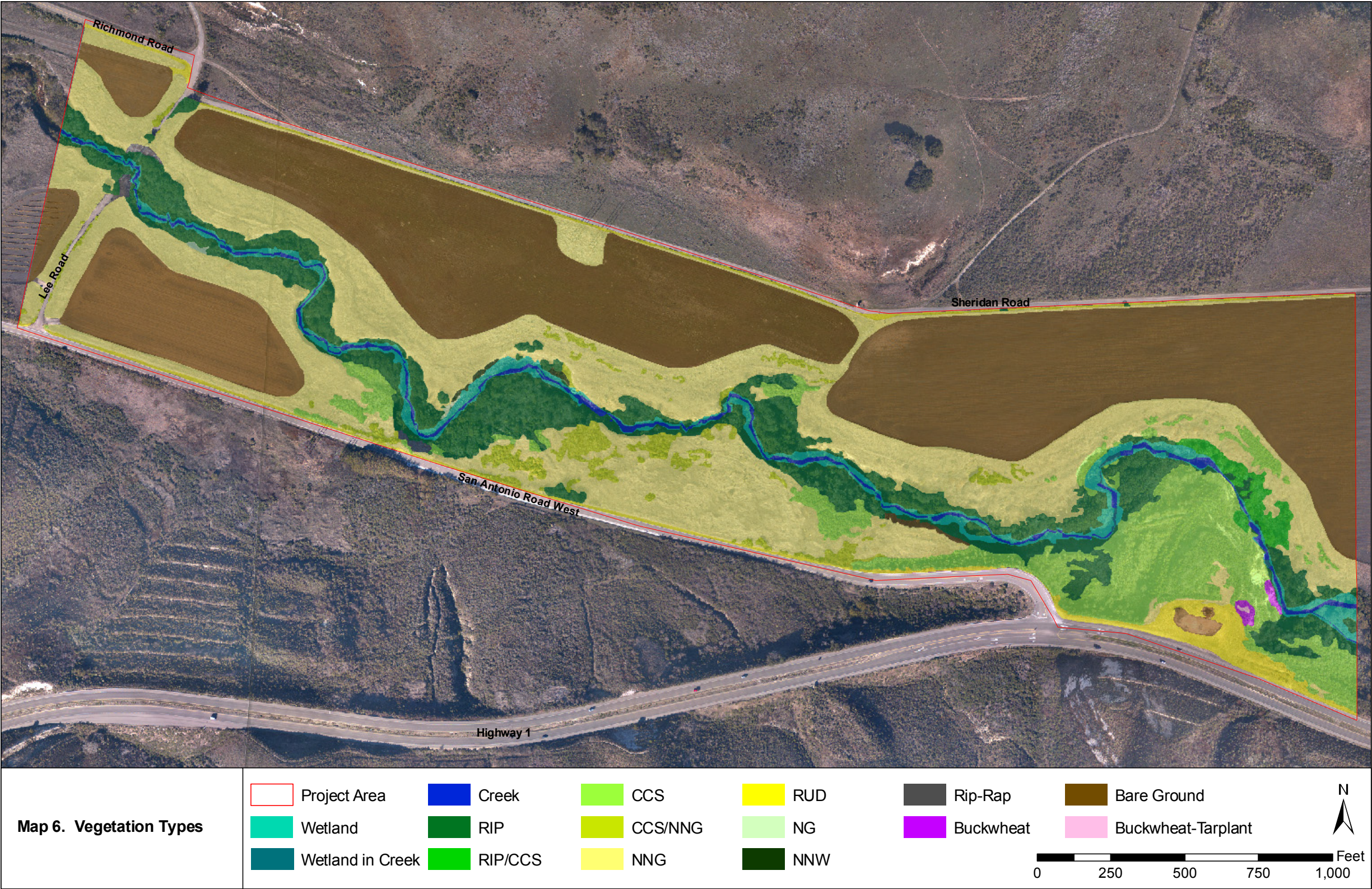


Figure 5. Shelving on the bank (left) and sediment deposits (right) were two features used to determine the OHWM.

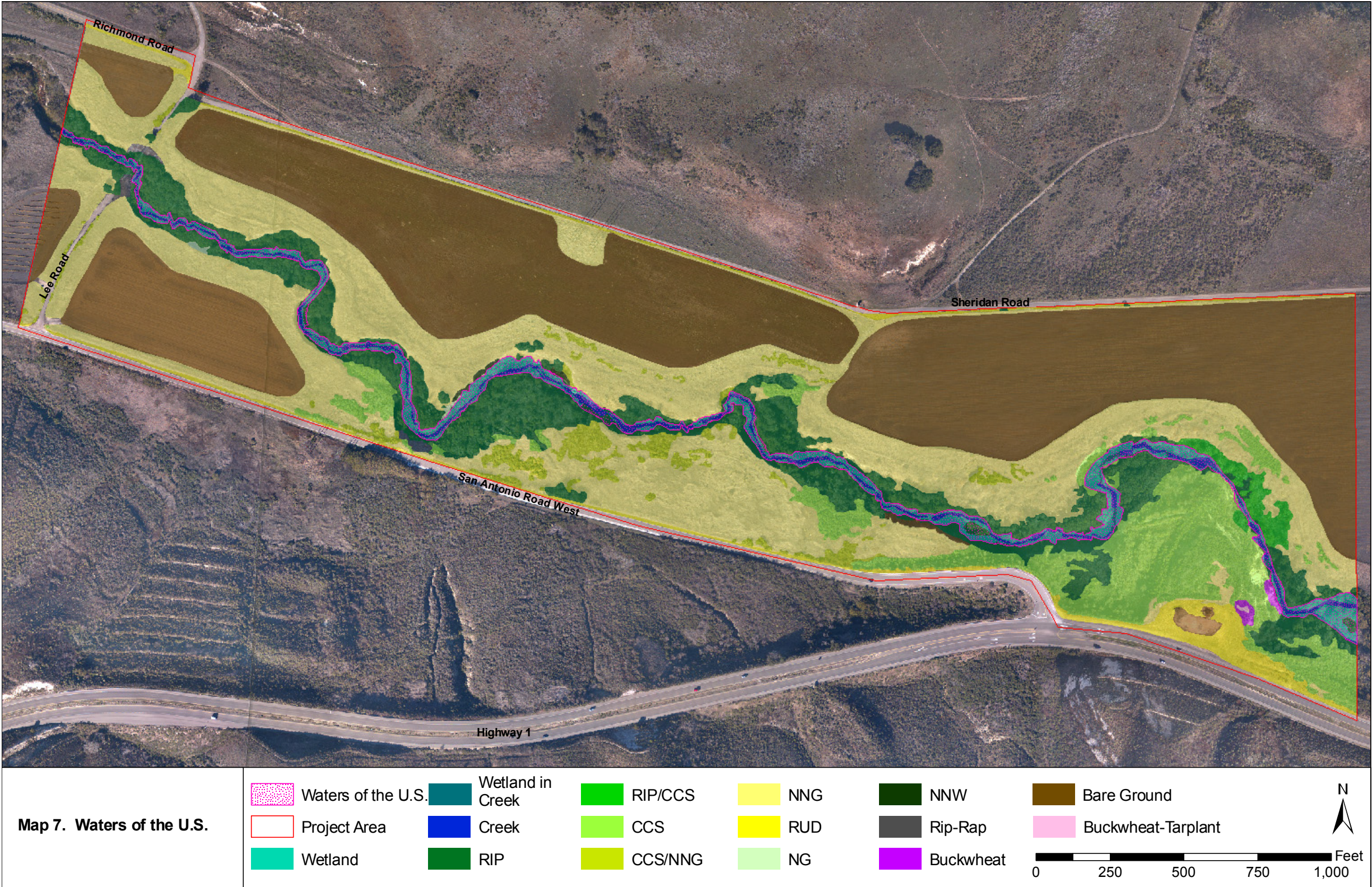
3.5 Field Surveys and Mapping

A total of 3.18 acres of wetlands were identified within the project area. Appendix 1 includes wetland delineation forms completed for each sample plot, and Appendix 2 includes a complete list of plant species observed during the wetland delineation. Maps 2, 3, 4, and 5 illustrate transect, sample plot, and wetland observation point locations. Map 6 illustrates vegetation types mapped within the project area. Map 7 illustrates the extent of Waters of the United States within the project area.

[This page intentionally left blank.]



[This page intentionally left blank.]



[This page intentionally left blank.]

4.0 Conclusion

Wetland habitats were delineated within the 105-acre project area following protocols established in the USACE 1987 Wetland Delineation Manual. A total of 3.18 acres of wetland habitat (freshwater marsh) were identified within the project area during the February through April 2008 field surveys. Vegetation in wetland habitats consists for fresh water marsh and riparian vegetation types. Waters of the United States encompass those areas mapped as wetlands as well as areas of open water and areas bound or encompassed by the OHWM. A total of 4.75 acres within the project area constitute Waters of the United States.

[This page intentionally left blank.]

5.0 Bibliography

- Hickman, J.C. (ed.). 1993. The Jepson Manual: Higher Plants of California. University of California Press, Berkeley. 1400pp.
- Holland, R.F. 1986. Preliminary Descriptions of the Terrestrial Natural Communities of California. California Department of Fish and Game, Sacramento.
- Keil, D.J., and V.L. Holland. 1998. Documented Flora of Vandenberg Air Force Base, Santa Barbara County, California. California Polytechnic State University, San Luis Obispo.
- Munsell Color Corporation. 2000. Soil Color Charts. New Windsor, NY.
- Tiner, R.W. Wetland Indicators, A Guide to Wetland Identification, Delineation, Classification, and Mapping. Lewis Publishers, NY. 392 pp.
- USACE. 1987. Corps of Engineers Wetlands Delineation Manual. U.S. Army Corps of Engineers, Waterways Experiment Station, Environmental Laboratory. Technical Report Y-87-1 January 1987. Vicksburg, MS.
- USACE. 2006. Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Arid West Region. U.S. Army Corps of Engineers, U.S. Army Engineer Research and Development Center. ERDC/EL TR06-16 December 2006. Vicksburg, MS.
- USDA. 2006. Field Indicators of Hydric Soils in the United States, Version 6.0. G.W. Hurt and L.M. Vasilas (eds.). United States Department of Agriculture, Natural Resources Conservation Service, in cooperation with the National Technical Committee for Hydric Soils. 38 pp.
- USDA. 1972. Soil Survey of Northern Santa Barbara Area, California. United States Department of Agriculture Soil Conservation Service, University of California Agricultural Experiment Station. 182 pp.
- USFWS. 1997. National List of Vascular Plant Species that Occur in Wetlands: 1996 National Summary. Biological Report 88(24). 209 pp.
- VAFB. *In Progress*. Environmental Assessment for the San Antonio Creek Restoration Project, Vandenberg Air Force Base, California.
- WTI. 1995. Field Guide for Wetland Delineation. 1987 Corps of Engineers Manual. Glenwood, NM. WTI 02-1. 143pp.
- WTI. 2003. Wetland Delineation Lecture Notes. R.J. Pierce (ed.). Wetland Training Institute. Glenwood, NM. WTI 02-1. 202 pp.

[This page intentionally left blank.]

Appendix 1: Wetland Delineation Forms

A complete appendix of all wetland delineation forms cited herein is available upon request from 30 CES/CEV, 1515 Iceland Avenue, Room 181C, Vandenberg AFB, CA 93437-5319, e-mailed to 30CES.CEV@vandenberg.af.mil, or faxed to 805/606-6137.

[This page intentionally left blank.]

Appendix 2: Plant Species Observed

<i>Species Name</i>	Common Name	Status	Wetland Indicator Status
<i>Acer negundo</i>	Box elder	native	FACW
<i>Amsinckia</i> sp.	Fiddleneck	native	UPL
<i>Artemisia californica</i>	California sagebrush	native	UPL
<i>Artemisia douglasiana</i>	Mugwort	native	FAC+
<i>Asphodelus fistulosus</i>	Asphodel	exotic	UPL
<i>Atriplex semibaccata</i>	Australian saltbush	exotic	FAC
<i>Avena barbata</i>	Slender wild oats	exotic	UPL
<i>Baccharis douglasii</i>	Marsh baccharis	native	OBL
<i>Baccharis pilularis</i>	Coyote bush	native	UPL
<i>Baccharis salicifolia</i>	Mule fat	native	FACW
<i>Brassica nigra</i>	Black mustard	exotic	UPL
<i>Brassica rapa</i>	Field mustard	exotic	UPL
<i>Bromus diandrus</i>	Ripgut brome	exotic	UPL
<i>Bromus hordeaceus</i>	Soft-chess brome	exotic	FACU-
<i>Calystegia macrostegia</i>	Morning-glory	native	UPL
<i>Carduus pycnocephalus</i>	Italian thistle	exotic	UPL
<i>Castilleja exserta</i>	Owl's clover	native	UPL
<i>Centaurea melitensis</i>	Tacolote	exotic	UPL
<i>Chenopodium californicum</i>	California goosefoot	native	UPL
<i>Chlorogalum pomeridianum</i>	Soap root	native	UPL
<i>Cirsium vulgare</i>	Bull thistle	exotic	FAC
<i>Clematis ligusticifolia</i>	Virgin's bower	native	FAC
<i>Conium maculatum</i>	Poison hemlock	exotic	FAC
<i>Conyza canadensis</i>	Common horseweed	exotic	FAC
<i>Cotula coronopifolia</i>	Brass buttons	exotic	FACW+
<i>Croton californicus</i>	Croton	native	UPL
<i>Cynodon dactylon</i>	Bermuda grass	exotic	FACU
<i>Cyperus eragrostis</i>	Umbrella sedge	native	FACW
<i>Deinandra increscens</i>	Tarplant	native	UPL
<i>Digitaria sanguinalis</i>	Crabgrass	exotic	FACU
<i>Distichlis spicata</i>	Salt grass	native	FACW
<i>Ehrharta calycina</i>	Veldt grass	exotic	UPL
<i>Epilobium ciliatum</i>	Willow-herb	native	FACW
<i>Ericameria ericoides</i>	Mock heather	native	UPL
<i>Eriogonum parvifolium</i>	Seacliff buckwheat	native	UPL
<i>Erodium botrys</i>	Storkbill filaree	exotic	FACU
<i>Erodium cicutarium</i>	Redstem filaree	exotic	UPL
<i>Euphorbia peplus</i>	Petty spurge	exotic	UPL
<i>Foeniculum vulgare</i>	Fennel	exotic	FACU-
<i>Galium aparine</i>	Common bedstraw	native	FACU
<i>Galium porrigens</i>	Climbing bedstraw	native	UPL
<i>Gnaphalium stramineum</i>	Annual everlasting	native	FAC-
<i>Gnaphalium californicum</i>	California everlasting	native	UPL

Species Name	Common Name	Status	Wetland Indicator Status
<i>Gnaphalium luteo-album</i>	Cudweed	exotic	FACW-
<i>Gnaphalium ramosissimum</i>	Pink everlasting	native	UPL
<i>Heliotropium curassavicum</i>	Heliotrope	native	OBL
<i>Heteromeles arbutifolia</i>	Toyon	native	UPL
<i>Heterotheca grandiflora</i>	Telegraph weed	native	UPL
<i>Hirschfeldia incana</i>	Perennial mustard	exotic	UPL
<i>Hordeum murinum</i>	Foxtail barely	exotic	UPL
<i>Juncus patens</i>	Spreading rush	native	FAC
<i>Lathyrus latifolius</i>	Sweet-pea	exotic	UPL
<i>Lepidium (Cardaria) draba</i>	Heart-podded hoary cress	exotic	UPL
<i>Leymus condensatus</i>	Giant wild-rye	native	FACU
<i>Leymus triticoides</i>	Beardless wild-rye	native	FAC+
<i>Lobularia maritima</i>	Sweet alyssum	exotic	UPL
<i>Lolium multiflorum</i>	Italian ryegrass	exotic	UPL
<i>Lotus scoparius</i>	Deerweed	native	UPL
<i>Malva nicaeensis</i>	Mallow	exotic	UPL
<i>Marah fabaceus</i>	Manroot	native	UPL
<i>Marrubium vulgare</i>	Horehound	exotic	FACU
<i>Medicago polymorpha</i>	Bur-clover	exotic	FACU-
<i>Melilotus sp.</i>	Sweet-clover	exotic	FAC
<i>Mimulus aurantiacus</i>	Sticky monkeyflower	native	UPL
<i>Nicotiana glauca</i>	Tree tobacco	exotic	FAC
<i>Phalaris minor</i>	Phalaris	exotic	UPL
<i>Picris echioides</i>	Bristly ox-tongue	exotic	FAC
<i>Plantago coronopus</i>	Cutleaf plantain	exotic	FAC
<i>Plantago lanceolata</i>	English plantain	exotic	FAC-
<i>Polygonum lapathifolium</i>	Willow smartweed	native	OBL
<i>Quercus agrifolia</i>	Coast live oak	native	UPL
<i>Raphanus sativus</i>	Wild radish	exotic	UPL
<i>Rorripa natsturtium-aquaticum</i>	Watercress	native	OBL
<i>Rosa californica</i>	California rose	native	FAC+
<i>Rubus ursinus</i>	California blackberry	native	FAC+
<i>Rumex acetosella</i>	Sheep sorrel	exotic	FAC-
<i>Rumex crispus</i>	Curly dock	exotic	FACW-
<i>Rumex salicifolius</i>	Willow dock	native	FACW
<i>Salix laevigata</i>	Red willow	native	FACW+
<i>Salix lasiolepis</i>	Arroyo willow	native	FACW
<i>Salix sitchensis</i>	Shining willow	native	FACW+
<i>Salsola tragus</i>	Russian thistle	exotic	UPL
<i>Sambucus mexicana</i>	Blue elderberry	native	FACU
<i>Sanicula crassicaulis</i>	Common sanicle	native	UPL
<i>Scirpus californicus</i>	California tule	native	OBL
<i>Scirpus americanus</i>	American three-square	native	OBL

<i>Species Name</i>	Common Name	Status	Wetland Indicator Status
<i>Scirpus microcarpus</i>	Small-fruited bulrush	native	OBL
<i>Scrophularia californica</i>	California figwort	native	FAC
<i>Silybum marianum</i>	Milk thistle	exotic	UPL
<i>Solanum douglasii</i>	Black nightshade	native	FAC
<i>Solanum xanti</i>	Purple nightshade	native	UPL
<i>Solidago confinis</i>	Goldenrod	native	FAC
<i>Sonchus asper</i>	Prickly sow-thistle	exotic	FAC
<i>Sonchus oleraceus</i>	Common sow-thistle	exotic	NI
<i>Spergularia bocconii</i>	Sand-spurry	exotic	FAC
<i>Spergularia marina</i>	Sand-spurry	native	FACW
<i>Toxicodendron diversilobum</i>	Poison oak	native	UPL
<i>Typha sp.</i>	Cattail	native	OBL
<i>Urtica dioica</i>	Stinging nettle	native	FACW
<i>Urtica urens</i>	Dwarf nettle	exotic	UPL
<i>Verbena lasiostachys</i>	Vervain	native	FAC-
<i>Vulpia myuros</i>	Rattail fescue	exotic	FACU

APPENDIX E

Cultural Resources

Appendix E. Cultural Resources

E.1 Prehistory

The prehistory of California's Central Coast spans the entire Holocene and may extend back to late Pleistocene times. In the Santa Barbara Channel region, a fluted Clovis point found on the surface of a coastal site suggests use of the area possibly as early as 11,000–12,000 years ago (Erlandson et al. 1987), while a site on San Miguel Island has yielded a radiocarbon date of 10,300 B.P. (Erlandson 1991). Recent calibrations suggest that terminal Pleistocene radiocarbon dates are about 2,000 years too recent (Fiedel 1999), and thus these early sites may be even older. In San Luis Obispo County, excavations at CA-SLO-2 in Diablo Canyon revealed an occupation older than 9,000 years (Greenwood 1972; Moratto 1984), and investigations at CA-SLO-1797 indicate initial occupations as early as 10,300 B.P. (Fitzgerald 2000). Occupations on VAFB occurred by at least 9,000 years ago, based on radiocarbon dates from CA-SBA-246 and CA-SBA-931, both near the mouth of the Santa Ynez River (Glassow 1990, 1996; Lebow et al. 2001), and on radiocarbon dates from CA-SBA-530 (Woodman et al. 1995; Lebow et al. 2002).

Moratto (1984) refers to these early occupations as Paleocoastal. Population densities were probably low, judging from the limited number of sites dated to this period. Diagnostic tools associated with this time period have not been identified, although similarities with the San Dieguito Complex in southern California (Wallace 1978; Warren 1967) have been suggested (Erlandson 1994). Cultural assemblages have few of the grinding implements common to subsequent periods. These sites are characterized by a strong maritime orientation and an apparent reliance on shellfish. Occupants are thought to have lived in small groups that had a relatively egalitarian social organization and a forager-type land-use strategy (Erlandson 1994; Glassow 1996; Greenwood 1972; Moratto 1984).

Site densities throughout the central coast are higher during the subsequent periods, suggesting increased population size and possibly better site preservation. Sites dating between about 8,000 and 6,500 years ago often have relatively high densities of manos and milling slabs that are typically associated with processing seeds. These milling stones are diagnostic of this period. Shellfish appear to have continued as a dietary staple throughout the central coast (Erlandson 1994; Glassow and Wilcox 1988), including VAFB (Glassow 1996; Woodman et al. 1995). However, terrestrial mammals composed a larger portion of the diet on VAFB during this period than during any other time (Glassow 1996; Rudolph 1991). Fish were a larger part of the diet than shellfish at Morro Bay in San Luis Obispo County, although shellfish were better represented during this period than during subsequent periods (Jones et al. 1994).

Early scholars associated sites of this age with inland knolls and terraces (e.g., Rogers 1929), but subsequent investigations revealed that coastal environments were also used (e.g., Glassow et al. 1988). Well-developed middens at many sites suggest a more sedentary and stable settlement system (Breschini et al. 1983). Glassow (1990, 1996) infers that occupants of VAFB during this time were sedentary and had begun using a collector-type (i.e., logistically mobile) land-use strategy. Burial practices suggest that society was primarily egalitarian (Glassow 1996).

Population densities appear to have decreased substantially between 6500 and 5000 B.P. throughout the region, and little is known about this period. It is possible that arid conditions

associated with the Altithermal degraded the environment to the point that only low population densities were possible (Glassow 1996; Glassow and Wilcoxon 1988).

After 5000 B.P., population densities increased to pre-6500 B.P. levels as conditions became cooler and moister. Between 5000 and 3000 B.P., mortars and pestles became increasingly common throughout the region, suggesting intensified use of acorns (Basgall 1987), although these implements may have been associated with processing pulpy roots or tubers (Glassow 1997). Along the Santa Barbara Channel coastline, use of shellfish declined as other animal foods became more important. Use of more diverse environmental settings is suggested (Erlandson 1997). On VAFB, fish and sea mammals composed a larger part of the diet during this period. Large side-notched and stemmed projectile points became more prevalent in the archaeological record, presumably reflecting increased hunting, although Glassow (1996) suggests that proportions of terrestrial mammals do not surpass the pre-6500 B.P. levels. However, higher proportions of terrestrial mammals in archaeological assemblages are associated with this period in San Luis Obispo County. Increased logistical organization is suggested in this area (Jones et al. 1994; Jones and Waugh 1995). Proportions of obsidian (indicating exchange with other regions) increased after about 5000 B.P., particularly in San Luis Obispo County (Jones et al. 1994; Jones and Waugh 1995).

Cultural complexity appears to have increased around 3,000–2,500 B.P. Based on mortuary data from the Santa Barbara area, King (1981, 1990) suggests a substantial change in social organization and political complexity about 3,000 years ago. According to King, high-status positions became hereditary and individuals began to accumulate wealth and control exchange systems. Arnold (1991, 1992) proposes that this evolutionary step in socioeconomic complexity occurred around 700–800 years ago.

The period between 2,500 and 800 years ago is marked by increased cultural complexity and technological innovation. Fishing and sea mammal hunting became increasingly important, corresponding to development of the tomol (a plank canoe), single-piece shell fishhooks, and harpoons (Glassow 1996; King 1990). The bow and arrow also was introduced during this period (Glenn 1990, 1991). Sites in San Luis Obispo County suggest that use of terrestrial mammals remained high. Proportions of imported obsidian continued to increase during this period (Jones et al. 1994).

Arnold (1992) proposes that the complex Chumash sociopolitical system known at historic contact evolved substantially during a brief period between A.D. 1150 and 1300, which she terms the Middle-Late Transitional Period. Arnold infers that decreased marine productivity caused by elevated sea-surface temperatures resulted in subsistence stress that allowed an elite population to control critical resources, labor, and key technologies, resulting in hierarchical social organization and a monetary system. Although the issue of elevated sea-surface temperatures has been questioned (e.g., Kennett 1998) and the inference of marine degradation and subsistence stress has been challenged (e.g., Raab et al. 1995; Raab and Larson 1997), the full emergence of Chumash cultural complexity around this time is generally accepted.

On VAFB and in the Santa Barbara Channel region, population densities reached peak levels between 700 years ago and historic contact (Glassow 1990, 1996). Higher numbers of *Olivella* shell beads reflect increased exchange between the Channel Islands, the Santa Barbara mainland, and the VAFB area. Increased subsistence diversity is apparent. Although shellfish continued to be a dietary staple in the Vandenberg area, the use of fish and birds increased, proportions of secondary species in shellfish assemblages increased (Glassow 1990), and dietary expansion is evident (Lebow and Harro 1998). Correspondingly, the range and diversity of site types increased as a greater range of habitats and resources was used (Glassow 1990; Lebow and Harro 1998; Woodman et al. 1991). In San Luis Obispo County, the settlement system appears to have

changed substantially after 700 B.P. as residential bases along the coast were abandoned in favor of habitation sites farther inland. Coastal sites were used to obtain resources during short-term occupations (Breschini and Haversat 1988; Greenwood 1972; Jones et al. 1994; Jones and Waugh 1995). In addition, proportions of imported obsidian decreased substantially during this period (Jones et al. 1994).

E.2 Ethnohistory

People living in the VAFB area prior to historic contact are grouped with the Purisimeño Chumash (Greenwood 1978; King 1984; Landberg 1965), one of several linguistically related members of the Chumash culture. Their social organization, traditions, cosmology, and material culture are described by Blackburn (1975), Grant (1978a, 1978b, 1978c, 1978d), Greenwood (1978), Hudson et al. (1977), Hudson and Blackburn (1982, 1985, 1986), Hudson and Underhay (1978), Johnson (1988), and Landberg (1965).

Accounts of early explorers in the Santa Barbara Channel area indicate that the Chumash people lived in large, densely populated villages with well-built structures (e.g., Bolton 1927, 1930; Engelhardt 1933; Fages 1937; Moriarity and Keistman 1968; Simpson 1939; Teggart 1911; Wagner 1929). With a total Chumash-speaking population estimated at 18,500 (Cook 1976) and employing a maritime economy, the Chumash had a culture that “was as elaborate as that of any hunter-gatherer society on earth” (Moratto 1984). Leadership was hereditary and chiefs exercised control over more than one village, reflecting a simple chiefdom social organization. The Chumash engaged in craft specialization and maintained exchange systems (Arnold 1992; Johnson 1988).

Relatively little is known about the Chumash in the Vandenberg region. Explorers noted that villages were smaller and lacked the formal structure found in the channel area (Greenwood 1978). The Purisimeño Chumash at historic contact used approximately 22 villages, with populations between 30 and 200 per village (Glassow 1996). King (1984) identifies about five ethnohistoric villages on VAFB, along with another five villages in the general vicinity.

Unfortunately, early explorers paid scant attention to Chumash subsistence and settlement systems. Using ethnohistoric, ethnographic, and archaeological data, Landberg (1965) attempted to reconstruct those facets of Chumash lifeways. Chumash subsistence relied primarily on fishing, hunting, and gathering plants (primarily acorns). In the spring, groups left their winter villages for temporary camps where they gathered grasses, roots, tubers, and bulbs. Hunting marine mammals became important during times when seals and sea lions congregated at their rookeries. Bulbs, roots, and tubers were gathered during the summer months as well, and seeds became important during this season, especially to the people north of Point Conception. Interior groups moved to the coast during the spring and summer to collect shellfish. Coastal groups returned to their villages in late summer and early fall to harvest large schooling fish such as tuna. Pine nuts were collected in the mountains during the fall months; acorns also were gathered in the late fall. Both of these resources, as well as berries collected during the late summer and early fall, were stored for use during the winter. Hunting also was important during the fall. Winter months were spent in villages, where residents relied primarily on stored foodstuffs as well as occasional fresh fish (Landberg 1965). Regional variation in subsistence strategies is evident in the ethnohistoric record (Landberg 1965); in the interior and along the northern coast of Chumash territory, marine resources were less important than acorns, seeds, and game (particularly deer).

Contact with early Euro-American explorers, beginning with the maritime voyages of Cabrillo in A.D. 1542–1543, undoubtedly had an effect on the Chumash culture. The effect may have been profound. Erlandson and Bartoy (1995, 1996) and Preston (1996) convincingly argue that Old

World diseases substantially impacted Chumash populations more than 200 years before Spanish occupation began in the 1770s.

Unquestionably, drastic changes to Chumash lifeways resulted from the Spanish occupation that began with the Portolá expedition in A.D. 1769. The first mission in Chumash territory was established in San Luis Obispo in 1772, followed in short order by San Buenaventura (1782), Santa Barbara (1786), and La Purísima Concepción, established in 1787 in the present location of Lompoc. The Mission Santa Ynez was established in 1804. Eventually, nearly the entire Chumash population was under the mission system (Grant 1978a). During the 1830s, the missions were secularized in an attempt to turn the mission centers into pueblos and make the Indians into Mexican citizens.

E.3 Bibliography

- Arnold, J.E. 1991. Transformation of a Regional Economy: Sociopolitical Evolution and the Production of Valuables in Southern California. *American Antiquity* 56:953–962.
- Arnold, J.E. 1992. Complex Hunter-Gatherer-Fishers of Prehistoric California: Chiefs, Specialists, and Maritime Adaptations of the Channel Islands. *American Antiquity* 57:60–84.
- Basgall, M.E. 1987. Resource Intensification among Hunter-Gatherers: Acorn Economies in Prehistoric California. *Research in Economic Anthropology* 9:21–52.
- Blackburn, T.C. 1975. *December's Child: A Book of Chumash Oral Narratives*. University of California Press, Berkeley.
- Bolton, H.E. 1927. *Fray Juan Crespi, Missionary Explorer on the Pacific Coast, 1769–1774*. University of California Press, Berkeley.
- Bolton, H.E. 1930. *Anza's California Expeditions*. 5 vols. University of California Press, Berkeley.
- Breschini, G.S., and T. Haversat. 1988. Archaeological Investigations at CA-SLO-99, Pismo Beach, San Luis Obispo County, California. *Coyote Press Archives of California Prehistory* 26. Coyote Press, Salinas, California.
- Breschini, G.S., T. Haversat, and R.P. Hampson. 1983. *A Cultural Resources Overview of the Coast and Coast-Valley Study Areas*. Coyote Press, Salinas, California.
- Cook, S.F. 1976. *The Population of California Indians, 1769–1770*. University of California Press, Berkeley.
- Engelhardt, Z. 1933. *Mission San Luis Obispo in the Valley of the Bears*. Mission Santa Barbara, Santa Barbara, California.
- Erlandson, J.M. 1991. Early Maritime Adaptations on the Northern Channel Islands. In *Hunters and Gatherers of Early Holocene Coastal California*, edited by Jon M. Erlandson and Roger H. Colten, pp. 101–111. *Perspectives in California Archaeology* 1. Institute of Archaeology, University of California, Los Angeles.
- Erlandson, J.M. 1994 *Early Hunter-Gatherers of the California Coast*. Plenum, New York.
- Erlandson, J.M. 1997 *The Middle Holocene on the Western Santa Barbara Coast*. In *Archaeology of the California Coast during the Middle Holocene*, edited by Jon M. Erlandson and Michael A. Glassow, pp. 91–109. *Perspectives in California Archaeology* 4. Institute of Archaeology, University of California, Los Angeles.
- Erlandson, J.M., and K. Bartoy. 1995. Cabrillo, the Chumash, and Old World Diseases. *Journal of California and Great Basin Anthropology* 17:153–173.
- Erlandson, J.M., and K. Bartoy. 1996. Protohistoric California: Paradise or Pandemic? *Proceedings of the Society for California Archaeology* 9:304–309.
- Erlandson, J.M., T.G. Cooley, and R. Carrico. 1987 A Fluted Projectile Point Fragment from the Southern California Coast: Chronology and Context at CA-SBA-1951. *Journal of California and Great Basin Anthropology* 9:120–128.
- Fages, P. 1937 *A Historical, Political, and Natural Description of California*. Translated by Herbert I. Priestly. University of California Press, Berkeley.

- Fiedel, S.J. 1999. Older than We Thought: Implications of Corrected Dates for Paleoindians. *American Antiquity* 64:95–115.
- Fitzgerald, R.T. 2000. Cross Creek: An Early Holocene/Millingstone Site. California State Water Project, Coast Branch Series, Paper Number 12. San Luis Obispo County Archaeological Society, San Luis Obispo, California.
- Glassow, M.A. 1996 Purisimeño Chumash Prehistory: Maritime Adaptations along the Southern California Coast. Case Studies in Archaeology. Jeffrey Quilter, series editor. Harcourt Brace College Publishers, San Diego.
- Glassow, M.A. 1997. Middle Holocene Cultural Development in the Central Santa Barbara Channel Region. In *Archaeology of the California Coast during the Middle Holocene*, edited by Jon M. Erlandson and Michael A. Glassow, pp. 73–90. *Perspectives in California Archaeology* 4. Institute of Archaeology, University of California, Los Angeles.
- Glassow, M.A. 1990. Archaeological Investigations on Vandenberg Air Force Base in Connection with the Development of Space Transportation System Facilities. Department of Anthropology, University of California, Santa Barbara. Submitted to USDI National Park Service, Western Region Interagency Archeological Services Branch, San Francisco, Contract No. CX-8099-2-0004.
- Glassow, M.A., and L.R. Wilcoxon. 1988. Coastal Adaptations near Point Conception, California, with Particular Regard to Shellfish Exploitation. *American Antiquity* 53:36–51.
- Glassow, M.A., L.R. Wilcoxon, and J.M. Erlandson. 1988. Cultural and Environmental Change during the Early Period of Santa Barbara Channel Prehistory. In *The Archaeology of Prehistoric Coastlines*, edited by Geoff N. Bailey and John E. Parkington, pp. 64–77. Cambridge University Press, Cambridge.
- Glenn, B.K. 1990. Typological Analysis of Projectile Points. In *Archaeological Investigations on Vandenberg Air Force Base in Connection with the Development of Space Transportation System Facilities*, vol. 2, edited by Michael A. Glassow, pp. A4-1–A4-45. Department of Anthropology, University of California, Santa Barbara. Submitted to USDI National Park Service, Western Region Interagency Archeological Services Branch, San Francisco, Contract No. CX 8099-2-0004.
- Glenn, B.K. 1991. Typological Analysis of Projectile Points Recovered from Excavation on Vandenberg Air Force Base, Santa Barbara County, California. Unpublished master's thesis, University of California, Santa Barbara.
- Grant, C. 1978a. Chumash: Introduction. In *California*, edited by Robert F. Heizer, pp. 505–508. *Handbook of North American Indians*, vol. 8, William C. Sturtevant, general editor. Smithsonian Institution, Washington, D.C.
- Grant, C. 1978b. Eastern Coastal Chumash. In *California*, edited by Robert F. Heizer, pp. 509–519. *Handbook of North American Indians*, vol. 8, William C. Sturtevant, general editor. Smithsonian Institution, Washington, D.C.
- Grant, C. 1978c. Interior Chumash. In *California*, edited by Robert F. Heizer, pp. 530–534. *Handbook of North American Indians*, vol. 8, William C. Sturtevant, general editor. Smithsonian Institution, Washington, D.C.
- Grant, C. 1978d. Island Chumash. In *California*, edited by Robert F. Heizer, pp. 524–529. *Handbook of North American Indians*, vol. 8, William C. Sturtevant, general editor. Smithsonian Institution, Washington, D.C.

- Greenwood, R.S. 1972. 9000 Years of Prehistory at Diablo Canyon, San Luis Obispo County, California. San Luis Obispo County Archaeological Society Occasional Paper No. 7.
- Greenwood, R.S. 1978. Obispeño and Purisimeño Chumash. In California, edited by Robert F. Heizer, pp. 520–523. Handbook of North American Indians, vol. 8, William C. Sturtevant, general editor. Smithsonian Institution, Washington, D.C.
- Hudson, T., and T.C. Blackburn. 1982. Food Procurement and Transportation. The Material Culture of the Chumash Interaction Sphere, vol. 1. Ballena Press Anthropological Papers No. 25. Ballena Press/Santa Barbara Museum of Natural History Cooperative Publication, Los Altos and Santa Barbara, California.
- Hudson, T., and T.C. Blackburn. 1985. Clothing, Ornamentation, and Grooming. The Material Culture of the Chumash Interaction Sphere, vol. 3. Ballena Press Anthropological Papers No. 28. Menlo Park, California.
- Hudson, T., and T.C. Blackburn. 1986. Ceremonial Paraphernalia, Games, and Amusement. The Material Culture of the Chumash Interaction Sphere, vol. 4. Ballena Press Anthropological Papers No. 30. Menlo Park, California.
- Hudson, T., T.C. Blackburn, R. Curletti, and J. Timbrook. 1977. The Eye of the Flute: Chumash Traditional History and Ritual, as told by Fernando Librado Kitsepawit to John P. Harrington. Malki Museum Press, Banning, California.
- Hudson, T., and E. Underhay. 1978. Crystals in the Sky: An Intellectual Odyssey Involving Chumash Astronomy, Cosmology, and Rock Art. Ballena Press Anthropological Papers 10. Socorro, New Mexico.
- Johnson, J.R. 1988. Chumash Social Organization: An Ethnohistoric Perspective. Ph.D. dissertation, Department of Anthropology, University of California, Santa Barbara.
- Jones, T.L., and G. Waugh. 1995. *Central* California Coastal Prehistory: A View from Little Pico Creek. Perspectives in California Archaeology 3. Institute of Archaeology, University of California, Los Angeles.
- Jones, T.L., K.M. Davis, G. Farris, S.D. Grantham, T.W. Fung, and B. Rivers. 1994. Towards a Prehistory of Morro Bay: Phase II Archaeological Investigations for the Highway 41 Widening Project, San Luis Obispo County, California. Submitted to California Department of Transportation, Environmental Branch, San Luis Obispo.
- Kennett, D.J. 1998. Behavioral Ecology and the Evolution of Hunter-Gatherer Societies on the Northern Channel Islands, California. Ph.D. dissertation, Department of Anthropology, University of California, Santa Barbara.
- King, C.D. 1981. The Evolution of Chumash Society: A Comparative Study of Artifacts Used in Social System Maintenance in the Santa Barbara Channel Region before A.D. 1804. Ph.D. dissertation, Department of Anthropology, University of California, Davis.
- King, C.D. 1984. Ethnohistoric Background. In Archaeological Investigations on the San Antonio Terrace, Vandenberg Air Force Base, California, in Connection with MX Facilities Construction, pp. I-1–I-54. Chambers Consultants and Planners, Stanton, California. Submitted to U.S. Army Corps of Engineers, Los Angeles District, Contract No. DAC09-81-C-0048.
- King, C.D. 1990. Evolution of Chumash Society: A Comparative Study of Artifacts Used for Social System Maintenance in the Santa Barbara Channel Region before A.D. 1804. The Evolution of North American Indians, edited by David Hurst Thomas. Garland, New York.

- Landberg, L. 1965. The Chumash Indians of Southern California. Southwest Museum Papers No. 19. Los Angeles.
- Lebow, C.G., and D.R. Harro. 1998. Plant Processing on the San Antonio Terrace: Archaeological Investigations at CA-SBA-2767. Applied EarthWorks, Inc., Fresno, California. Submitted to Central Coast Water Authority, Buellton, California.
- Lebow, C.G., D.R. Harro, R.L. McKim, and C. Denardo. 2001. Archaeological Excavations at CA-SBA-246, An Early Holocene Site on Vandenberg Air Force Base, Santa Barbara County, California. Applied EarthWorks, Inc., Fresno, California, for Tetra Tech, Inc., Santa Barbara, California. Submitted to 30 CES/CEV, Vandenberg Air Force Base, California, USAF Contract No. F04684-95-C-0045.
- Lebow, C.G., D.R. Harro, R.L. McKim, and C. Denardo. 2002. Archaeological Excavations at the Honda Beach Site (CA-SBA-530), Vandenberg Air Force Base, Santa Barbara County, California. Applied EarthWorks, Inc., Fresno, California, for Tetra Tech, Inc., Santa Barbara, California. Submitted to 30 CES/CEVPC, Vandenberg Air Force Base, California, AFCEE Contract No. F41684-00-D-8029.
- Moratto, M.J. 1984. California Archaeology. Academic Press, New York and London.
- Moriarty, J.R., and M. Keistman. 1968. Cabrillo's Log 1542–1543: A Voyage of Discovery (a Summary by Juan Paez). The Western Explorer 5(2–3):1–20. Cabrillo Historical Association, San Diego, California.
- Preston, W. 1996. Serpent in Eden: Dispersal of Foreign Diseases into Pre-Mission California. Journal of California and Great Basin Anthropology 18:2–37.
- Raab, L.M., K. Bradford, J.F. Porcasi, and W.J. Howard. 1995. Return to Little Harbor, Santa Catalina Island, California: A Critique of the Marine Paleotemperature Model. American Antiquity 60:287–308.
- Raab, L.M., and D.O. Larson. 1997. Medieval Climatic Anomaly and Punctuated Cultural Evolution in Coastal Southern California. American Antiquity 62:319–336.
- Rogers, D.B. 1929. Prehistoric Man of the Santa Barbara Coast, California. Santa Barbara Museum of Natural History Special Publications No. 1.
- Rudolph, T.P. 1991. Settlement Organization in the Lower Santa Ynez River Valley: 9000 B.P. to Contact. In Western Chumash Prehistory: Resource Use and Settlement in the Santa Ynez River Valley, edited by Craig F. Woodman, James L. Rudolph, and Teresa P. Rudolph, pp. 307–338. Science Applications International Corporation, Santa Barbara, California. Prepared for the Unocal Corporation. Submitted to U.S. Army Corps of Engineers, Los Angeles District.
- Simpson, L.B. 1939. California in 1792: The Expedition of Longinos Martinez. Huntington Library, San Marino, California.
- Teggart, F.J. 1911. The Portolá Expedition of 1769–1770: Diary of Miguel Costansó. Publications of the Academy of Pacific Coast History 2(4):164–327. Berkeley, California.
- Wagner, H.R. 1929. Spanish Voyages to the Northwest Coast in the Sixteenth Century. California Historical Society, San Francisco.
- Wallace, W.J. 1978. Southern Valley Yokuts. In California, edited by Robert F. Heizer, pp. 448–461. Handbook of North American Indians, vol. 8, William C. Sturtevant, general editor. Smithsonian Institution, Washington, D.C.

- Warren, C.N. 1967. The San Dieguito Complex: A Review and Hypothesis. *American Antiquity* 32:168–185.
- Woodman, C.F., C. Cagle, P. de Barros, and T. P. Rudolph. 1995. Final Report, Archaeological Survey and Evaluation of the Honda Beach Site, SBA-530. Science Applications International Corporation and Chambers Group, Inc., Santa Barbara, California. Submitted to USDI National Park Service, Western Region Interagency Archeological Services Branch, San Francisco, Contract No. 1443 CX 8000-92-010.
- Woodman, C.F., J.L. Rudolph, and T.P. Rudolph. 1991. Western Chumash Prehistory: Resource Use and Settlement in the Santa Ynez River Valley. Science Applications International Corporation, Santa Barbara, California. Prepared for the Unocal Corporation. Submitted to U.S. Army Corps of Engineers, Los Angeles District.